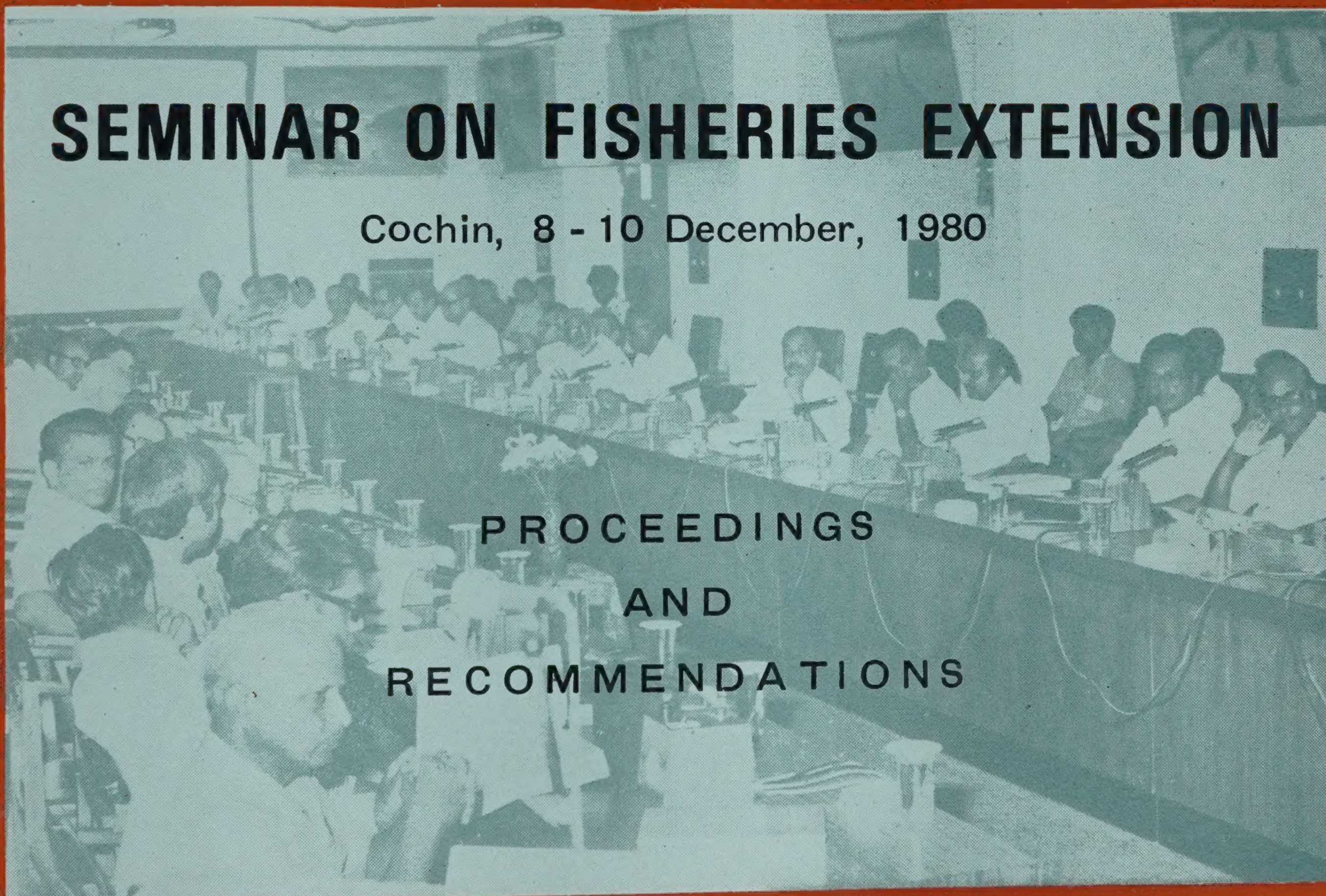
MARINE FISHERIES INFORMATION SERVICE



SPECIAL ISSUE

Technical and Extension Series

No. 27
JANUARY, FEBRUARY
MARCH
1981

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE
COCHIN, INDIA

INDIAN COUNCIL OF AGRICULTURAL RESEARCH

THE MARINE FISHERIES INFORMATION SERVICE: Technical and Extension Series envisages the rapid dissemination of information on marine and brackish water fishery resources and allied data available with the Fishery Data Centre and the Research Divisions of the Institute, results of proven researches for transfer of technology to the fish farmers and industry and of other relevant information needed for Research and Development efforts in the marine fisheries sector.

Abbreviation – *Mar. Fish. Infor. Serv. T & E Ser., No.* 27: 1981

Cover Photo:

Delegates representing the States, Union Territories, Agricultural Universities, ICAR Fisheries Institutes, Department of Agriculture (Government of India) and Marine Products Export Development Authority participating in the Seminar

SEMINAR ON
FISHERIES EXTENSION
COCHIN

8 - 10 December, 1980

Organised by

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE, COCHIN
CENTRAL INLAND FISHERIES RESEARCH INSTITUTE, BARRACKPORE
CENTRAL INSTITUTE OF FISHERIES TECHNOLOGY, COCHIN
CENTRAL INSTITUTE OF FISHERIES EDUCATION, BOMBAY

CONVENER

DR. E. G. SILAS
Director, CMFRI, Cochin

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PREFACE

It has been well recognised that fisheries extension is one of the weakest links in the development programmes for fisheries in our country. In other fields of production such as agriculture, dairying and poultry, extension has played a major role in the application of technology for increasing production. In the fisheries sector, although a small beginning was made in the fifties by starting extension programmes the effort soon became dissipated. It never made much progress although, Plan after Plan, emphasis was laid on fisheries development. In the words of the National Commission on Agriculture "Absence of adequate work in fisheries extension has been one of the principal reasons for the slow pace of inland fisheries development." Extension service in the marine fisheries sector is much less enviable.

In spite of a half-hearted approach to fisheries extension, the country has made some progress in fish production. From a base level of 0.75 million tonnes in the beginning of the first Five-Year Plan, we have reached a production of over 2.2 million tonnes towards the end of the Fifth Plan. Although there has been use of new technology in certain fields which contributed to the increase in production, the fact remains that we have been operating in areas which were underexploited. Increase in effort always resulted in higher production in the past. But the present experience shows that unless the fish production system is put on a much broader technological base and the required extension infrastructure is provided, any substantial increase in fish production would be difficult to achieve.

Fortunately the country has made the right approach in developing research, education and training infrastructure for aiding fisheries development in the form of various fisheries research, education and training institutes and agricultural universities. The research institutes in particular, during the last three decades, have built up a wealth of information on the fishery resources of the marine, brackishwater and inland water areas and have also developed technologies for production through capture and culture and for post-harvest treatment. However, it is a fact that the technologies remain very much underutilised. The absence of a motivated extension set-up in the country has been responsible for the underutilisation of the technologies.

The character of fisheries development has vastly changed today and we are in the threshold of a new era, armed with better knowledge of the fishery resources, the opportunity of an Exclusive Economic Zone in our seas, improved and new technologies for increasing production through culture, a well-established processing industry, greater research support and above all a realisation of its potential as one of the Nation's major assets and we have the political will to assign priority to this sector. These tools and aids for increasing production will be meaningful only if the agency for transformation, namely the extension service, is strong and creative.

Realising the immediate need to bring into focus fisheries extension, the Central Marine Fisheries Research Institute desired to organise a forum for discussing the subject by bringing together the different fisheries interests in the country. This resulted in the *Seminar on Fisheries Extension* jointly organised by the four fisheries institutes of the Indian Council of Agricultural Research, namely the Central Marine Fisheries Research Institute, Central Inland Fisheries Research Institute, Central Institute of Fisheries Technology and Central Institute of Fisheries Education.

The objectives of the Seminar were:

1. To provide for the first time in the country a national forum to those engaged in fisheries extension to come together.

2. To discuss the state of art of fisheries extension in the country.

3. To identify the lacunae and needs of fisheries extension.

4. To develop a National Policy and to evolve an action plan for strengthening and streamlining fisheries extension in the country.

The Seminar was conducted at the Central Institute of Fisheries Technology, Cochin from 8–10 December 1980.

The plan of the Seminar included:

1. Invitation of status reports on fisheries extension from all the maritime and inland states and Union Territories which are responsible for fisheries development.

2. Invitation of background papers on fisheries extension from the Department of Agriculture, Government of India, ICAR Fisheries Institutes,

Fisheries Faculties of Agricultural Universities, and other fisheries organisations.

3. Presentation of the status reports and background papers at the different technical sessions and discussions.

4. Constitution of Task Forces on major identified areas to draft action plans for strengthening fisheries extension, which the participants themselves would be able to implement.

5. Holding of Plenary Session to discuss and finalise recommendations of the Seminar.

6. Organising an Exhibition on Fisheries Extension to highlight the latest developments in the field.

The scope of each invited paper was planned in advance and elaborate guidelines were prepared in order to obtain comprehensive information on fisheries extension from each of the organisations and to ensure uniformity in format. All the 35 status reports/background papers were cyclostyled and brought out in the book form for distribution to the delegates. This enabled cutting down the presentation time and providing more opportunities for discussion at the Technical Sessions.

It is realised that this first Seminar on the subject cannot fulfil all the tasks and find solutions to all the problems; nevertheless it would contribute to a better understanding of the magnitude of the problems and prospects at the National level and would form the basis for future discussions. We would acquire consciousness of this vital force and make extension an inalienable organic link of fisheries planning and development through a public policy.

The Seminar has made very important recommendations on various subjects relating to fisheries extension. Since these were made by the delegates themselves who represent the whole spectrum of fisheries interest in the country, it is anticipated that the recommendations will be implemented by the various organisations without much difficulty.

The Indian Council of Agricultural Research, recognising the importance of the topic of fisheries extension, approved the proposal for organising the Seminar on Fisheries Extension. I am grateful to Dr. O. P. Gautam, Director General, ICAR for his overall guidance in organising the Symposium.

Late Shri G. K. Kuriyan, former Director, CIFT, Cochin was a source of immense strength in planning the Seminar. Dr. S. N. Dwivedi, Director, CIFT, Dr. A. V. Natarajan, Director, CIFRI and Dr. C. C. Panduranga Rao, Director, CIFT, as co-sponsors of the Seminar extended valuable support. Dr. S. N. Dwivedi, Shri M. M. Mohanty, (late) Shri A. G. Vasavan, Shri M. Swaminath and Prof. H.P.C. Shetty chaired the different technical sessions of the Seminar. Shri K. H. Alikunhi presided over the concluding Plenary Session and guided the discussions on recommendations. Dr. M. J. Sebastian, Dr. C. C. Panduranga Rao, Dr. Devesh Kishore, Shri. M. M. Mohanty, Dr. S. N. Dwivedi and Dr. A. V. Natarajan took up the responsibility for convening the task forces and formulating the draft recommendations.

The success of the Seminar is entirely due to the interest shown by the Department of Fisheries of the States/Union Territories, Fisheries Faculties of the Agricultural Universities, the Fisheries Division and Extension Directorate of the Department of Agriculture, Government of India, Marine Products Export Development Authority, Fisheries Institutes of the Indian Council of Agricultural Research, National Academy of Agricultural Research Management and the V. M. National Institute of Co-operative Management. To all the above organisations and officers who contributed status and background papers I owe my thanks. I am thankful to all the delegates of the Seminar and the observers for their participation and useful discussions.

I am thankful to the Directorate of Extension of the Ministry of Agriculture, Central Fisheries Extension Training Centre of CIFE, Department of Fisheries, Government of Tamilnadu, Central Institute of Fisheries Technology and Central Marine Fisheries Research Institute for their active participation in the exhibition. My thanks are due to CMFRI and the Regional Shrimp Hatchery of Government of Kerala for organising the field visits for the delegates. The Central Institute of Fisheries Technology provided the facilities for holding the seminar and also for lunch and tea arrangements.

The committees constituted to look after the various arrangements for the conduct of the seminar did a fine job and I am thankful to the conveners and members of the committees for their help.

Dr. K. Alagarswami gave excellent support in planning, organising and conducting the Seminar and also in bringing out the publications.

E. G. SILAS
Convener
Seminar on Fisheries Extension

SUMMARY OF PROCEEDINGS

Welcoming the delegates to the Seminar at the first Plenary Session held on 8th December 1980, Dr. E. G. Silas, Convener, stressed the importance of the seminar in the context of the present phase of fisheries development for increasing fish production through use of appropriate technologies. He traced the genesis of the seminar and pointed out that for the first time in the country a forum has been organised to discuss the vital link of fisheries extension between technology development and utilisation. He requested the delegates to give serious thoughts to identify the problems and evolve an action plan for strengthening fisheries extension.

Dr. E. G. Silas, Convener of the Seminar welcoming the delegates.

Technical Sessions

The business of the seminar was held under five technical sessions on the 8th and 9th December 1980. The sessions were organised as follows:

I. Status of fisheries extension in coastal states.
II. Status of fisheries extension in non-coastal states.
III. Fisheries extension in agricultural universities.
IV. Background papers from Ministry of Agriculture and MPEDA.
V. Fisheries extension in ICAR fisheries institutes.

The sessions were chaired respectively by Dr. S. N. Dwivedi, Shri M. M. Mohanty, Shri A.G. Vasavan, Shri M. Swaminath and Prof. H. P. C. Shetty.

Twelve status reports were presented at the first Session and the coastal States/Union Territories which presented the papers for discussion were Kerala, Maharashtra, Tamil Nadu, Gujarat, Karnataka, Andhra Pradesh, Orissa (4 papers), Pondicherry and Lakshadweep. At Session II Arunachal Pradesh, Haryana, Punjab, Sikkim, Tripura and Meghalaya presented status reports on fisheries extension. The presentation at Session III included background papers on fisheries extension in Agricultural Universities of Karnataka, Tamil Nadu, Kerala, Andhra Pradesh, Konkan Krishi Vidya Peeth, Panjabrao Krishi Vidya Peeth, G.B. Pant University of Agriculture and Technology and Bidhan Chandra Viswa Vidyalaya. At Session IV two papers from the Fisheries Division of the Department of Agriculture, Government of India and one from the Marine Products Export Development Authority were presented. An interesting paper on the use of super-8 mm movie in fisheries extension was presented by the Directorate of Extension, Ministry of Agriculture. At Session V the ICAR fisheries institutes namely the CMFRI, CIFRI, CIFT and CIFE presented background papers dealing essentially with the technologies developed at the respective institutes and also the training and transfer of technology programmes under implementation. A paper on use of mass media was presented by the National Academy for Agricultural Research Management of ICAR. The status reports and background papers were discussed at the end of each session.

Task Forces

One of the major objectives of the seminar was to evolve an action plan for strengthening fisheries extension. Six major areas were identified as requiring consideration of the seminar and task forces were constituted to follow the presentation and discussions at the seminar and to prepare draft action plans/recommendations on the subject areas. Each task force was led by a convener and 10 to 12 delegates were identified to be associated with each task force. An outline of the scope of the subject area was also prepared and supplied to each task force. The task forces constituted are as follows:

1. Organisational set-up and linkages.
2. Technological needs of fisheries extension.
3. Fisheries extension methods.
4. Input supply and output management.

Shri K. H. Alikunhi, Fisheries Advisor, Government of Kerala giving an overview of fisheries extension in the State of Kerala (Left to Right: Dr. C. C. Panduranga Rao, Director, CIFT, Dr. S. N. Dwivedi, Director, CIFE, Dr. E. G. Silas, Director, CMFRI, Dr. A. V. Natarajan, Director, CIFRI and Shri K. H. Alikunhi).

5. Extension education and training.
6. Public policies and planning for fisheries extension.

The task forces were convened respectively by Dr. M. J. Sebastian, Dr. C. C. Panduranga Rao, Dr. Devesh Kishore, Shri M. M. Mohanty, Dr. S. N. Dwivedi and Dr. A. V. Natarajan.

After the technical sessions concluded in the forenoon of 9–12–1980, the task forces met independently in the afternoon and drafted the recommendations. Late in the evening, the convener of each task force presented the draft recommendations at the Plenary Session II and a preliminary discussion was held on the drafts. Based on the discussion the recommendations were redrafted.

Final Plenary Session

At the final Plenary Session held in the forenoon of 10–12–1980 at the Prawn Culture Laboratory of Central Marine Fisheries Research Institute at Narakkal, the draft recommendations were presented and discussed at length. Shri K. H. Alikunhi chaired the Session. The amendments, suggestions and points of view expressed by the delegates were noted. The House constituted an Editorial Committee consisting of Shri K. H. Alikunhi, Dr. E. G. Silas, Dr. C. C. Panduranga Rao and Dr. K. Alagarswami to edit and finalise the recommendations of the seminar based on the draft documents and the discussions at the Plenary Session.

The Seminar concluded with a vote of thanks proposed by Dr. C. C. Panduranga Rao.

Special lecture

Realising the importance of fisheries co-operatives as one of the agencies of fisheries extension, a special lecture was arranged on "Fisheries co-operatives in India—Performance, problems and prospects" by Dr. G. S. Kamat, Professor at the V. M. National Institute of Co-operative Management, Pune. The lecture was delivered by him in the evening of 9–12–1980.

Exhibition

An exhibition on fisheries extension was organised at the CIFT premises to highlight the fisheries extension activities of different organisations and to focus attention on extension methods. The Directorate of Extension in the Department of Agriculture, Government of India took a leading part in the display of fisheries extension materials and particularly demonstrated the use of super-8 mm movie in extension. The Central Fisheries Extension Training Centre of CIFE at Hyderabad played a major role in the display of several audio-visual equipment and other extension materials. Other organisations which participated in the exhibition were the Department of Fisheries, Government of Tamil Nadu, the Central Institute of Fisheries Technology and the Central Marine Fisheries Research Institute.

Field visits

On 10–12–1980 the delegates were taken on a field visit to the Lab-to-Land Transfer of Technology centre

Shri M. M. Mohanty, Director of Fisheries, Orissa, addressing the Seminar.

Shri A. K. Kawatra, Director and Warden of Fisheries, Punjab, presenting the status paper.

Shri K. Raha, Joint Director of Fisheries, Tripura presenting the status paper on fisheries extension.

at Valappu near Cochin where the CMFRI is engaged in transferring prawn culture technology to a Harijan society consisting of 122 families as members. The delegates also visited the prawn culture laboratory of CMFRI at Narakkal. In the afternoon a visit was arranged to the Regional Shrimp Hatchery of the Department of Fisheries, Government of Kerala at Azhikode which marked the close of the Seminar's Programmes.

Recommendations of the Seminar

The Editorial Committee constituted by the seminar subsequently met and finalised the recommendations. A total of 22 recommendations have been made under six headings and the organisations have been identified for taking action on them. The recommendations have been included under a separate section in this proceedings.

LIST OF STATUS REPORTS/BACKGROUND PAPERS

I. STATUS REPORTS ON FISHERIES EXTENSION

A. Coastal States

1. Department of Fisheries, Kerala, Trivandrum (A .G. Vasavan)
2. Department of Fisheries, Maharashtra, Bombay (S. S. Naik)
3. Department of Fisheries, Tamilnadu, Madras (C. Chellappan)
4. Department of Fisheries, Gujarat, Ahmedabad (U. L. Wadekar)
5. Department of Fisheries, Karnataka, Bangalore (K. Sripad Rao)
6. Department of Fisheries, Andhra Pradesh, Hyderabad (M. Venkateshwara Rao)
7. Department of Fisheries, Orissa, Cuttack (M. M. Mohanty)
8. Progress of Fisheries Extension Service in Orissa (J. C. Roy)
9. The Saga of Fisheries Extension in Western Orissa (M. K. Ahmed)
10. Role of FFDA, Balasore in extension of intensive pisciculture (R. K. Das)
11. Department of Fisheries, Pondicherry (E. Purushothaman)
12. Department of Fisheries, U. T. of Lakshadweep, Kavaratti (George Varghese)

B. Non-coastal States

13. Department of Fisheries, Arunachal Pradesh, New Itahnagar (A. K. Das)
14. Department of Fisheries, Haryana, Chandigarh (D. K. Kaushik)
15. Department of Fisheries, Punjab, Chandigarh (A. K. Kawatra)
16. Fish & Wildlife Department, Sikkim, Gangtok (Fisheries Development Officer)

Professor H. P. C. Shetty, Director of Instruction (Fisheries) University of Agricultural Sciences, Karnataka speaking on fisheries extension of the Fisheries College.

17. Department of Fisheries, Tripura, Agartala (K. Raha)

18. Department of Fisheries, Meghalaya, Shillong (Deputy Director of Fisheries)

II. FISHERIES EXTENSION IN AGRICULTURAL UNIVERSITIES

19. Fisheries extension and related activities in the University of Agricultural Sciences, Karnataka–College of Fisheries, Mangalore (H. P. C. Shetty)
20. Fisheries extension activities at the Fisheries College, Tamil Nadu Agricultural University, Tuticorin (K. C. Joseph)
21. Fisheries extension programmes of the Faculty of Fisheries in Kerala Agricultual University, College of Fisheries, Mannuthy (M. J. Sebastian)
22. Fisheries research and extension programmes of the Faculty of Fisheries of Konkan Krishi Vidyapeeth (G. A. Shirgur)
23. Agricultural Universities–an aid to fisheries extension (L. M. Joshi, Punjabrao Krishi Vidyapeeth)
24. Fisheries extension programmes of Faculty of Fisheries of Andhra Pradesh Agricultural University (T. Rajyalakshmi)
25. Achievement and extension of fisheries research at G. B. Pant University of Agriculture and Technology (C. S. Singh)
26 Utilisation of information sources in the adoption of recommended species of fish in composite fish culture (G. L. Ray and M. A. Haque)

Shri V. D. Kapoor, Exhibition Officer, Ministry of Agriculture, presenting the paper at the seminar.

III. BACKGROUND PAPERS FROM MINISTRY OF AGRICULTURE AND MARINE PRODUCTS EXPORT DEVELOPMENT AUTHORITY

27. Approach to Fisheries Extension in India (T. A. Mammen, Fish. Div., Min. Agri.)
28. Introduction of fisheries extension service for development of inland fish farming (V. D. Singh and V. Sampath, Fish. Div., Min. Agri.)
29. Fishery extension in production for export (M. Sakthivel, P. U. Verghese and R. Ganapathy, MPEDA).
30. Improved techniques on fisheries production and processing come to life through super 8 mm movies (C. S. S. Rao, Directorate of Extension)

Dr. S. N. Dwivedi, Director, CIFE, speakig on fisheries extension activities of the Institute and its training centres.

The Plenary Session to discuss the recommendations was held at the CMFRI Prawn Culture Laboratory at Narakkal. (Left to Right: Dr. E. G. Silas, Dr. S. N. Dwivedi, Shri K. H. Alikunhi, Dr. M. J. Sebastian, Dr. A. V. Natarajan, Dr. Devesh Kishore, Shri M. M. Mohanty, Dr. C. C. P. Rao—Chairmen of the different sessions of the Seminar)

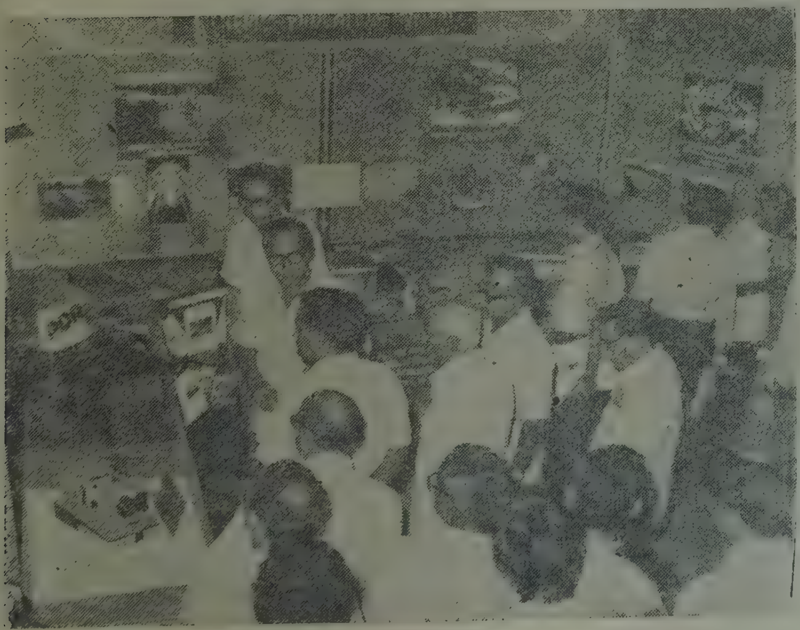
Dr. C. C. P. Rao, Director, CIFT explaining the Lab-to-Land programme and other extension activities at the exhibition.

IV. FISHERIES EXTENSION IN ICAR FISHERIES INSTITUTES

31. Technology generation and transfer for marine fisheries development–Central Marine Fisheries Research Institute, Cochin
32. Technology generation and transfer for fisheries development–Central Institute of Fisheries Technology, Cochin
33. Contributions of Central Inland Fisheries Research Institute in technology generation, verification, education and dissemination in inland fishery sector—CIFRI, Barrackpore
34. Fisheries education and extension training–Central Institute of Fisheries Education, Bombay (H. G. Hingorani, CFETC, Hyderabad)
35. Role of mass media in fisheries extension (Devesh Kishore, National Academy of Agricultural Research Management, Hyderabad)

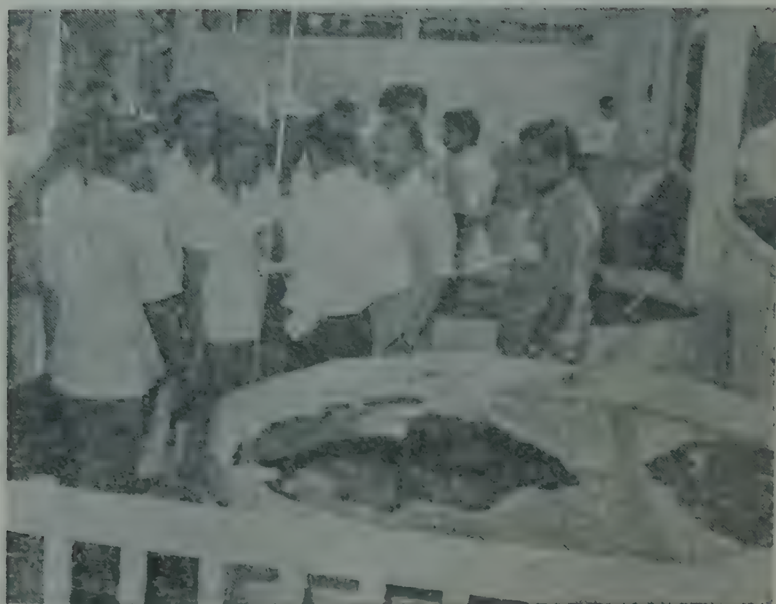
V. SPECIAL LECTURE

36. Fisheries Co-operatives in India—performance, problems and prospects (G. S. Kamat, V. M. National Inst. Co-op. Management, Pune).



Shri H. G. Hingorani, Principal, CFETC, Hyderabad explaining the audiovisual aids at the fisheries extension exhibition.

Shri K. H. Alikunhi releasing the extension pamphlet on pearlspot brought out by the Krishi Vigyan Kendra on Mariculture of CMFRI at Narakkal (seen in the foreground are Dr. V. Balakrishnan, OIC, Krishi Vigyan Kendra, Shri K. H. Alikunhi and (late) Shri A. G. Vasavan, Director of Fisheries, Kerala.)



The delegates of the seminar visited the Prawn Culture Laboratory of CMFRI at Narakkal. Shri K. H. Mohamed, Scientist-in-charge of PCL explains the activities.

A visit to the Lab-to-Land centre of CMFRI at Valappu where the technology of prawn culture is under transfer to the member-families of a Harijan society.

The field programme for the delegates concluded with a visit to the Regional Shrimp Hatchery of the Department of Fisheries, Government of Kerala, at Azhikode.

SEMINAR ON FISHERIES EXTENSION

LIST OF RECOMMENDATIONS

1. PUBLIC POLICIES AND PLANNING FOR FISHERIES EXTENSION
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2. ORGANISATIONAL SET-UP AND LINKAGES
   - 2.1. Strengthening of fisheries extension set-up
   - 2.2. Linkages
3. TECHNOLOGICAL NEEDS OF FISHERIES EXTENSION
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   - 3.2. Forecasting and fisheries information
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5. EXTENSION EDUCATION AND TRAINING
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   - 5.3. Fisheries extension training
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   - 5.5. Non-formal education
6. FISHERIES EXTENSION METHODS
   - 6.1. Training in extension methods
   - 6.2. Provision of equipment at extension centres

RECOMMENDATIONS

1. PUBLIC POLICIES AND PLANNING FOR FISHERIES EXTENSION

1.1. General policy and priorities

The Seminar,

realising that at present fisheries extension is one of the weakest links in our fisheries development programmes and that the existing extension service is totally inadequate and ill-equipped to meet the challenges and utilise the opportunities for enhancing fish production and improving rural economy, and

taking into consideration the views and recommendations of the Balwant Rai Mehta Commission (1957) and National Commission on Agriculture (1976) on fisheries extension,

recommends that the Government may give high priority to fisheries extension and integrate extension as a part of programme planning for fisheries development in the country both at the National and State level and provide adequate administrative, financial and infrastructure support for efficient functioning of fisheries extension.

Action: Department of Agriculture, Government of India; Indian Council of Agricultural Research; Agricultural Universities; Fisheries Departments of States/Union Territories.

1.2. Streamlining fisheries extension

The Seminar,

recognising that there are several organisations in the country engaged in fisheries research, development, education and training and all of them have some extension programmes or other, and

realising that it is necessary to broadly demarcate the responsibilities of different organisations as far as fisheries extension is concerned to avoid

duplication of efforts and to eliminate confusion in the minds of the beneficiaries,

recommends that the Department of Fisheries of the States/Union Territories may have the full responsibility for field extension programmes, the Agricultural Universities for extension education, the Central Institutes for national demonstrations and technical training, and the Department of Agriculture and Co-operation, Government of India for providing adequate financial support for fisheries extension programmes in the States/Union Territories and co-ordinating their functions.

Action: Department of Agriculture, Government of India; Indian Council of Agricultural Research; Agricultural Universities; Fisheries Departments of States/Union Territories.

1.3. Status for fisheries extension

The Seminar,

pointing out that one of the reasons for the absence of competent extension service in fisheries is the lack of qualified manpower, and

stressing that since the extension workers have a pivotal role to play in introducing improved technologies and promoting progress in fisheries development they should be professionally competent and must have an insight into and outlook for sociological problems and needs related to development,

recommends that an unified approach may be adopted by the States/Union Territories for giving a proper status to fisheries extension and extension workers; only persons who are qualified, competent and who have the required aptitude may be drafted to fisheries extension; and that at the block/village level the fisheries extension worker may be made responsible for fisheries extension programmes with minimum involvement in other development activities.

Action: Fisheries Departments of States/Union Territories.

1.4. Leasing of water bodies

The Seminar,

considering that proper development of aquaculture could be brought about through fisheries extension service only if the fish culturists have access to control over water bodies to be cultivated, and

noting that the public water bodies are generally under the control of the Government or public organisations such as panchayats,

recommends that the Government may evolve a clear policy to lease out the public water bodies to prospective aquaculturists and

further recommends that priority may be given to the backward segment of the society particularly to landless labour, tribals and scheduled castes/tribes, provided they are interested in taking up aquaculture, and to undergo training and develop skills as fish farmers.

Action: Department of Agriculture, Government of India; Fisheries Departments of States/Union Territories.

1.5. Fish inspection and quality control for internal marketing

The Seminar,

noting that there is no system to check and ensure the quality of fish offered for sale at landing sites and marketing centres and that an agency for inspection and quality control exists exclusively for the export trade, and

stressing that it is equally important to ensure that the consumer gets wholesome fish as per specified standards of quality,

recommends that quality control measures be developed for fish and shellfish sold in the internal market and that the States/Union Territories make a beginning to implement fish inspection system through local public health organisations.

Action: Department of Agriculture, Government of India; Indian Standards Institute; Indian Council of Agricultural Research; Council of Scientific and Industrial Research; Fisheries and Public Health Departments of States/Union Territories.

1.6. Development of suitable systems of fisheries extension

The Seminar,

taking into account the diversified nature of Indian fisheries in diverse agro and hydroclimatic conditions and different types of culture and capture fisheries requiring a wide range of technologies and skill of operation, and

realising the need for developing models and systems of fisheries extension appropriate for each of the above situations,

> *recommends* that the Centre may take the responsibility for developing and testing selected systems of fisheries extension in particular States/Union Territories and, based on the results, recommend such system to other regions.

Action: Department of Agriculture, Government of India; Fisheries Departments of States/Union Territories.

2. ORGANISATIONAL SET-UP AND LINKAGES

2.1. Strengthening of fisheries extension set-up

The Seminar,

observing that the organisational set-up for fisheries extension in the Central as well as State sectors is very weak,

noting that even the nominal set-up existing at present differs from State to State depending on the priorities assigned to fisheries development and resources available, and

stressing that a strong fisheries extension set-up is an essential pre-requisite to a creative and effective extension system,

> *recommends* that at the Central level the extension set-up and functions of the Fisheries Division of the Department of Agriculture & Co-operation, Ministry of Agriculture and the extension education and demonstration set-up and functions of the Indian Council of Agricultural Research be strengthened for providing necessary planning, system support and effective co-ordination of the various fisheries extension activities in the country, and
>
> *further recommends* that fisheries extension set-up be strengthened in all the States and Union Territories with appropriate trained manpower at the senior level in the Directorate, middle level in the districts and operative level in the blocks and villages to manage, execute and operate the various programmes of fisheries extension.

Action: Department of Agriculture, Government of India; Indian Council of Agricultural Research; Agricultural Universities; Fisheries Departments of States/Union Territories.

2.2. Linkages

The Seminar,

realising that at present there is very little linkage between the extension organisations of the different States/Union Territories, and between Central and State Fisheries Departments, and

stressing the need for establishing close linkages and co-ordination among the various organisations on matters relating to fisheries extension,

> *recommends* that explicit linkages among the extension systems of the Fisheries Organisations of the Centre, States/Union Territories and Agricultural Universities, and between extension and input supply agencies be established at different levels to ensure prompt transfer of technology and efficient extension service.

Action: Department of Agriculture, Government of India; Indian Council of Agricultural Research; Agricultural Universities; Fisheries Departments of States/Union Territories.

3. TECHNOLOGICAL NEEDS OF FISHERIES EXTENSION

3.1. Inventory of technologies

The Seminar,

noting with satisfacation that a wide range of pre-harvest, harvest and post-harvest technologies in marine, brackishwater and inland fisheries sectors are available at the ICAR Fisheries Research Institutes and Agricultural Universities, and

pointing out that while some of these technologies have been accepted and adopted by the fishermen

and fish farmers, there are several others which await practical use in production,

recommends that an inventory of tested and proven technologies with details be prepared by the ICAR Fisheries Research Institutes and Agricultural Universities, indicating different levels of operation and utilisation and be made available to the Fisheries Departments of the States/Union Territories and Extension Centres, and

further recommends that taking a cue from the package of technology being delivered to other production sectors, similar packages of technology to suit different categories of recipients, with particular emphasis on low-input technology to meet the needs of the weaker sections of the community, be developed and provided to the extension agencies.

Action: Indian Council of Agricultural Research; Agricultural Universities; Fisheries Departments of States/Union Territories.

3.2. Forecasting and fisheries information

The Seminar,

drawing attention to the need for providing information to the fishermen and fish farmers on the immediate prospects of production and also information on resources, technology, marketing and other areas which are immediately useful,

recommends that the Research Institutes should develop a credible system for effective forecasting to alert the fishermen or fish farmers on the short-term prospects of production and also on the long-term prospects and that the Research and Education Institutes, Agricultural Universities and Development Agencies, in co-ordination, should develop a viable system of fisheries information service for dissemination of all information, including meteorological information, relating to fisheries. The extension system in the States/Union Territories should be the agency for the communication and follow-up assistance to the fishermen, fish farmers and entrepreneurs.

Action: Indian Council of Agricultural Research; Agricultural Universities; Fisheries Departments of States/Union Territories.

3.3. Conservation of ecosystem

The Seminar,

pointing out that the fishermen and fish farmers do not realise the implications of indiscriminate exploitation of the resources and are not conscientious about the ill effects of over exploitation and abuse of valuable water resources,

recommends that the extension workers should create an awareness and understanding in the fishermen and fish farmers of aspects of conservation and management of the resources and also of protection of environment against its impairment through pollution and other factors.

Action: Fisheries Departments of States/Union Territories.

3.4. Feed-back

The Seminar,

realising the importance of getting feed-back information for evaluation and use by the technology production system,

recommends that the extension system should collect comprehensive feed-back information from the production sectors and pass it on to the Research Institutes and Agricultural Universities for evaluation and use in further improvement, refinement and innovations of technologies.

Action: Indian Council of Agricultural Research; Agricultural Universities; Fisheries Departments of States/Union Territories.

4. INPUT SUPPLY AND OUTPUT MANAGEMENT

4.1. Involvement of extension in input supply and output management

The Seminar,

considering that input supply and output management as aids and functions of fisheries extension would be the core of the problem in any attempt to substantially increase fish production in capture as well as culture fisheries in the inland, brackish-water and marine sectors, and

realising that while identification of inputs and outputs of fisheries extension is not so difficult a task, fruitful and precise operational solutions seem imposing,

recommends that the fisheries extension set-up should be geared to the needs of supply of inputs such as fertilisers, chemicals, implements, fuel oil and energy and also output management, particularly marketing, and provide timely assistance to the fishermen and fish farmers through co-operative and other institutional channels.

Action: Fisheries Departments of States/Union Territories.

4.2. Fish seed production

The Seminar,

noting that fish seed is usually subject to excessive mortality during storage and transportation, and

realising that a smooth and timely supply of fish seed is very important,

recommends that while encouraging increased fish seed production in the private sector, the existing departmental and corporation levels of fish seed production be stepped up and the supply network be refined and extended to panchayat level without seriously disturbing the supply network in the private sector.

Action: Fisheries Departments of States/Union Territories.

4.3. Multipurpose fisheries co-operatives

The Seminar,

considering that despite the mixed success of the fisheries co-operatives in India, the importance of co-operative effort cannot be underestimated in the present socio-economic context, and

realising the need for organising multipurpose fisheries co-operatives to provide various services connected with fisheries development,

recommends that formation of new multipurpose fisheries co-operatives be explored by the fisheries extension staff and such societies be given priority in fisheries development programmes.

Action: Fisheries Departments of States/Union Territories.

5. EXTENSION EDUCATION AND TRAINING

5.1. Fisheries extension education

The Seminar,

noting that extension education in fisheries is yet to take its roots in the country in spite of three decades of planned development of fisheries, and

observing that the present education and training facilities at the Research and Education Institutes and Agricultural Universities do not cater to the needs of fisheries extension,

recommends that the existing curriculum of fisheries education in the undergraduate programmes of the Agricultural Universities be suitably altered wherever necessary to include credits on "Extension Methodology" in order to provide the basic structure of extension education at this level, and

further recommends that facilities be provided for specialising in extension education at the post-graduate level in the Agricultural Universities in order to create a cadre of fisheries extension specialists.

Action: Indian Council of Agricultural Research; Agricultural Universities.

5.2. Extension research

The Seminar,

realising that there is need for improving the extension system on a scientific basis,

recommends that researches in extension education and extension methods be taken up at the Agricultural Universities in order to evolve appropriate extension systems and methods suitable for the different fisheries sectors.

Action: Agricultural Universities.

5.3. Fisheries extension training

The Seminar,

considering that training facilities in fisheries extension are available only at one centre in the country, namely the Central Fisheries Extension

Training Centre (CFETC), Hyderabad, and that no such facility is available for extension training in marine fisheries and post-harvest technology,

recommends that the training facilities at CFETC be expanded and strengthened and be fully availed of by the Fisheries Departments of the States and Union Territories, and

further recommends that specialised training facilities for extension in marine fisheries and post-harvest technology sectors be created.

Action: Indian Council of Agricultural Research; Fisheries Departments of States/Union Territories.

5.4. Trainers Training Centres and Krishi Vigyan Kendras

The Seminar,

observing that the concept of introducing Trainers Training Centres (TTCs) and Krishi Vigyan Kendras (KVKs) in the fisheries sector by the Indian Council of Agricultural Research is a new venture and is already proving its usefulness towards providing vocational training,

recommends that such facilities of TTCs and KVKs be extended on selective basis in a phased manner based on actual needs.

Action: Indian Council of Agricultural Research.

5.5. Non-formal education

The Seminar,

noting that the fishermen of the country are mostly illiterate and therefore extension programmes may not have desired impact unless the target groups are properly prepared and guided for the proposed changes,

recommends that non-formal education and self-employment programmes for the fishermen and fish farmers be introduced by the Agricultural Universities, Departments of Fisheries, Co-operative Institutions and Voluntary Organisations.

Action: Agricultural Universities; Fisheries Departments of States/Union Territories.

6. FISHERIES EXTENSION METHODS

6.1. Training in extension methods

The Seminar,

considering the fact that at present fisheries extension is carried out by staff inadequately trained in extension methods, and

observing that the present methods, including production of extension literature, often do not fully take into account the level and socio-economic status of the intended audience,

recommends that the Fisheries Departments of the States and Union Territories may plan accelerated training programmes for extension workers on the effective use of mass media such as radio, television, newspapers and exhibitions and other allied aspects of extension and communication systems.

Action: Fisheries Departments of States/Union Territories.

6.2. Provision of equipment at extension centres

The Seminar,

noting that extension is a multi-faceted field-oriented discipline and can succeed only if the required infrastructure is made available,

recommends that the Departments of Fisheries of the States and Union Territories may be suitably equipped with units for production of material for extension methods and that all district-level extension units be provided with equipments such as film and slide projectors, tape recorder, megaphone, camera, graphic aid material and exhibits and, if possible, also a mobile extension unit.

Action: Fisheries Departments of States/Union Territories.

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MARINE FISHERIES INFORMATION SERVICE

Technical and Extension Series

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE

COCHIN, INDIA

INDIAN COUNCIL OF AGRICULTURAL RESEARCH

No. 28
APRIL, MAY, JUNE
1981

THE MARINE FISHERIES INFORMATION SERVICE: Technical and Extension Series envisages the rapid dissemination of information on marine and brackish water fishery resources and allied data available with the Fishery Data Centre and the Research Divisions of the Institute, results of proven researches for transfer of technology to the fish farmers and industry and of other relevant information needed for Research and Development efforts in the marine fisheries sector.

Abbreviation – *Mar. Fish. Infor. Serv. T & E Ser., No.* 28: 1981

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Cover Photo: Shrimp trawlers at Mangalore

BY-CATCH OF THE SHRIMP FISHERY IN INDIA*

Introduction

With the increasing demand for shrimps and consequent large scale shrimp trawling operations, considerable quantities of other fishes which are collectively termed as "trash fish" are landed everywhere. A survey of these catches would show that while in some countries these fishes are utilised in one way or other, in other countries they are wasted. A recent study undertaken by the International Development Research Centre (IDRC) Canada in collaboration with Food and Agriculture Organisation of the United Nations shows that every year as much as 21 million tonnes of edible marine fish are thrown away at sea by shrimp trawlers, which amounts to roughly the same quantity of fish eaten annually by the people of the developing countries. Surpisingly enough most of the waste occurs off the coasts of those countries where food is in short supply. Needless to say that in a world of increasing hunger we cannot afford to indulge in the luxury of this practice of dumping the trash fish over-board the fishing vessel. However, in India except for a very negligible quantity of catches contributed by some crustaceans and other miscellaneous varieties very little is wasted. In this connection a study was made to understand the shrimping by–catch and its utilisation in this country and the results are reported here.

Crafts and gear employed in shrimp fishing

Fishing crafts

A variety of indigenous crafts is used in shrimp fishery, from the simple catamarans of the east coast to the well-built canoes of Maharashtra on the west coast. Motorised pablo boats and small and large sized trawlers are engaged in shrimp trawling. Although the process of mechanisation of crafts has been in progress for the past several years, indigenous crafts like catamaran, canoes and plank-built boats are still operating in the small scale sector. According to 1973–77 census there were 1,06,480 non-mechanised crafts.

Catamarans: The catamarans are primitive types of crafts used on the surf beaten coast, consisting of 3 to 5 logs tied together in a raft fashion. In different areas the size and number of the logs used vary slightly. Usually 2 to 4 men operate the craft.

Canoes: The dug-out canoes are most common along the west coast, made by hollowing out a single log of wood and of varying sizes from 6.10 to 12.5 m length. Boat seines, shore seines, gill nets and cast nets are operated from these canoes often with a crew of 4 to 8 men. Plank-built canoes, out-rigger canoes and flat-bottom canoes are also in use in different areas.

Plank-built boats: These are sturdy boats used in the northern part of both east and west coasts, used for bag net fishing. Manned by 7 to 12 men, these are considered most suited for mechanisation and quite a number of them have been mechanised. The length of the boat ranges from 6.5 to 13.0 m. The various types of plank–built boats have been indigenously evolved on the basis of their suitability for operation in the respective local condition.

Mechanised crafts: Motorisation of the indigenous crafts was the first step in the mechanisation of shrimp fishing. In due course many designs of small and medium sized mechanised boats to be operated from harbours and sheltered bays were introduced. The number of mechanised crafts currently in operation is 12,000. Shrimp trawling is mostly carried out by the Dan boats (6.6 x 2.2 x 1.0 m), Pablo boats (7.4x 2.1 x 1.05 m) and the shrimp trawlers (9.6 x 3.1 x 1.2m and above). The horse power of the smaller boats ranged from 10 to 60. The larger of these boats are partly or fully decked and with trawling winches. Larger steel trawlers fitted with 90–300 HP engines and refrigerated fish holds are operated by some of the big firms as well as the Exploratory Fisheries Projects of the Government. The number of larger trawlers amounts to 75–100.

Fishing gear

As in the case of fishing crafts, a variety of indigenous gears are operated for capturing shrimps in addition

*Prepared by M. J. George, C. Suseelan and K. Balan

to the trawl nets. Nearly 0.7 million gears of assorted types are operated in the country. According to the mode of operation the gears can be grouped under the following categories.

Fixed or stationary nets: These include the various types and sizes of bag nets and stake nets operated against the flow of the tide in both inshore waters and brackish water areas The bag nets constitute the most. important gears for shrimp fishing in Maharashtra and Gujarat coasts, where they are locally known as 'Dol nets'. Depending on the manner in which these nets are operated there are two types, namely *Khunt fishing* and *Sus fishing*. The nets are conical in shape, with a wide rectangular mouth. The size varies considerably, from 12 to 200 m in length with cod end mesh size of 10 mm. 'There are different types of bag nets operated in West Bengal and Andhra Pradesh also, locally known as *'Behundi Jal'* and *'Thoka vala'* respectively in these two areas. The fixed nets known as stake nets are in operation in the backwaters of west coast as well as east coast.

Seine nets: The seine nets include the seines with or without bags (and wings). They are known as boat-seines or shore seines depending upon whether they are hauled from a boat or from the beach. One of the important gears operated by the indigenous craft along Kerala coast is the boat seine known as *Thangu vala* of various dimensions, usually operated by two dug-out canoes with 6–10 men. Boat seines of different types and dimensions are in operation for catching shrimps in other areas also.

Although the shore seines are mostly used for catching inshore pelagic fishes, prawns are also caught in these nets. Shore seines of varying sizes are in use in all the areas of the coast-line.

Cast nets or falling nets: These are very common and primitive gears used all along the coast and limited in their efficiency. They are operated by a single person very near the shore in the open sea as well as in the creeks and estuaries. The size of the net varies from 2.5 to 6.0 m in radius with webbing of mesh size 10 to 20 mm. The net is cast, fully spread and as it closes traps the fishes and prawns in the water column below the net.

Scoop nets or skimming nets: These are employed exclusively in the creeks and backwaters and comprise of the hand net, push net and lift net. The Chinese dip nets of Kerala backwaters is a type of lift net.

Drift nets: The drift nets are passive wall nets of selective nature, also called gill nets made of cotton, hemp or synthetic fibre. The gill nets are at present increasingly used in fishing larger sized shrimps from the sea in certain regions.

Trawl nets: With the increase in demand for shrimps for processing and export, along with the mechanisation of the fishery stern trawling, particularly for shrimps, was attempted even with small mechanised boats and met with unprecedented success. Consequent to the expansion of the shrimp industry in a big way this new fishing method has come to stay, although indigenous crafts and gears are also being operated catching shrimps to a certain extent.

Otter trawls are the most effective gears operated for shrimp fishing, the sizes of the trawl nets varying with the sizes of the crafts from which they are operated. Generally two or four seam trawl nets, overhang or non-overhang type with headline length of 7–27 m between the upper wing ends are used. Depending on the dimensions of the net and the towing power required the size and weight of the otter boards vary. The Indian Standards Institution has also brought out requisite standards for the stern trawling gears for the different class of vessels.

Several new designs of trawling gear were introduced during the last few years. Design of a 15.25 m four-seam trawl for operation from a 9.45 m trawler is very popular. In addition to these trawls, bulged belly trawls are also in use. A 15 m bulged belly trawl suitable for 10.97 m trawler is being increasingly used. Some of the larger trawlers are resorting to out-rigger trawling.

Estimation of quantity of by-catch

A considerable quantity of fishes by way of by-catch from shrimp trawling as well as indigenous shrimp fishery, consisting of both trash fishes of cheaper varieties and quality table fishes is landed in India. Thus a bottom fishery or demersal fishery of very high magnitude exists in the country. In a total marine catch of 13,88,380 tonnes in 1979, 6,40,027 tonnes were contributed by demersal catches including those of indigenous fishery, the details of which are given in Table 1. In a total landings of 3,98,945 tonnes by smaller trawlers the fish and other miscellaneous by-catches apart from shrimp amounted to 3,15,902 tonnes, forming 79.18% in 1979 (Table 2). Maximum by-catch is seen in Tamil Nadu followed by Gujarat, Kerala and Maha-

Table 1. *Statewise distribution of bottom fishery during* 1979
(in tonnes)

State	Trawler catch: Shrimp	Trawler catch: Fish	Total demersal catch including indigenous	Total marine catch
West Bengal	—	—	4,325	10,744
Orissa	2,160	7,275	28,675	51,808
Andhra Pradesh	5,373	23,312	49,377	91,426
Tamil Nadu	8,216	83,496	1,22,085	2,35,008
Pondicherry	492	3,158	4,273	10,068
Kerala	24,512	54,952	1,02,237	3,30,509
Karnataka	3,857	18,157	28,495	1,26,384
Goa	1,559	6,493	9,558	25,388
Maharashtra	31,242	48,788	1,86,102	2,93,326
Gujarat	5,632	70,271	86,836	1,91,312
Andamans	—	—	576	1,721
Lakshadwip	—	—	648	3,846
Private trawlers (large)	743	16,097	16,840	16,840
TOTAL	83,786	3,31,999	6,40,027	13,88,380

rashtra. The percentage of by-catch is maximum in Gujarat followed by Tamil Nadu and Pondicherry. It is at the minimum in Maharashtra and Kerala.

The details of landings (provisional) of commercial shrimp trawlers at some selected centres in the different maritime states during 1980 is given in Table 3. It is seen that among all the centres Sakthikulangara (Neendakara) in Kerala State shows the maximum units operated as well as landings of both fish by-catches and shrimps. It is interesting to note that the percentage of by-catch during the year is also at the minimum of 54.98 in this centre. At Cochin, the other centre of observation in Kerala also the percentage of by-catch is comparatively low. Sassoon Dock in Bombay comes next in the quantity of by-catch and shrimps landed by the trawlers, as can be seen in the table.

Table 2. *Landings of prawns and by-catches of commercial shrimp trawlers in different maritime states during* 1979

Maritime States	Total landings (tonnes)	Prawn catch (tonnes)	By-catch in tonnes: Other Crustaceans	By-catch in tonnes: Cephalopods	By-catch in tonnes: Fish	By-catch in tonnes: Total	Percentage of by-catch in total landings
Gujarat	75,903	5,632	939	4,824	64,508	70,271	92.58
Maharashtra	80,030	31,242	880	3,104	44,804	48,788	60.96
Goa	8,052	1,559	1,315	73	5,105	6,493	80.63
Karnataka	22,014	3,857	2,459	41	15,657	18,157	82.47
Kerala	79,464	24,512	7,384	1,536	46,032	54,952	69.15
Tamil Nadu	91,712	8,216	2,290	837	80,369	83,496	91.04
Pondicherry	3,650	492	98	39	3,021	3,158	86.52
Andhra Pradesh	28,685	5,373	352	474	22,486	23,312	81.26
Orissa	9,435	2,160	—	—	7,275	7,275	77.10
ALL INDIA	3,98,945	83,043	15,717	10,928	2,89,257	3,15,902	79.18

Table 3. *Landings of prawns and by-catches (in tonnes) of commercial shrimp trawlers at selected centres during* 1980 *(Provisional)*

Centres	Number of units operated	Total landings	Prawn catch	By-catch: Other Crustaceans	By-catch: Fish	By-catch: Miscellaneous items	By-catch: Total	Percentage of by-catch in total landings
Bombay (Sassoon Dock)	21,469	18,144	5,138	4	12,924	78	13,006	71.68
Mangalore (Tadri)	7,922	2,417	353	1	1,779	284	2,064	85.39
Cochin	46,096	7,912	3,514	704	3,416	278	4,398	55.58
Sakthikulangara (Neendakara)	1,72,732	81,213	36,559	4,167	36,607	3,880	44,654	54.98
Tuticorin	31,517	6,417	534	12	5,871	—	5,883	91.67
Mandapam	25,143	2,533	217	151	2,047	118	2,316	91.43
Rameswaram	78,758	14,378	1,367	602	11,692	717	13,011	90.49
Nagapatnam	9,307	2,007	125	26	1,729	127	1,882	93.77
Cuddalore	16,012	1,969	121	31	1,642	175	1,848	93.85
Pudumanikuppam	13,154	1,416	165	62	919	270	1,251	88.34
Kakinada	41,174	9,025	2,698	352	5,557	418	6,327	70.10
Visakhapatnam	35,406	8,051	784	400	6,325	542	7,267	90.26

From the total by-catch including various groups of fishes and miscellaneous items consisting of crustaceans other than shrimps, cephalopods etc. only negligible quantity is being discarded. From a total by-catch of 3,15,902 tonnes in 1979, only an insignificant quantity of 5,000 tonnes (1.5%) consisting of *Squilla* and miscellaneous items such as young ones of fishes and shrimps and crabs were discarded. In the case of the smaller trawlers when the shrimp catches are unusually heavy the fish by-catches are discarded over-board due to lack of space for storage and transport to the shore base. From the larger trawlers operated, most of the smaller fish by-catch is discarded at sea, about which data is not available.

Statewise details of seasonal landings of by-catches during 1979 is given in Table 4. In all the states along the west coast of India except Kerala the by-catches are at the maximum during the south west monsoon months of June to August, there being not much of fishing operations by the small trawlers in the monsoon months. However, Kerala State shows the maximum in these months, mostly brought about by the peak activity of the shrimp fishing boats at Neendakara area. In Tamil Nadu along the east coast the by-catches are more or less evenly landed in almost all the year round, the maximum being in February, March and June and the minimum in September. Andhra Pradesh landed maximum in September, October and minimum in May and June. In Pondicherry the maximum by-catch landings were in June to September period, minimum being in November to January season.

Species and size composition in by-catches

The by-catches landed by shrimp trawlers include a wide variety of demersal fishes and a few species of cephalopods and crustaceans other than prawns. Among fishes, the most common items represented in the landings of the different maritime states are: Elasmobranchs, eels, catfishes, dorabs, lizard fish, perches, polynemids, sciaenids, ribbon-fishes, carangids, silver bellies, white fish, barracudas and soles (Fig. 1&2). The statewise abundance and seasonal distribution of major categories of by-catches for the year 1979 are shown in Table 5 and Fig. 3 respectively. Table 6 indicates the common size range of individual categories.

Elasmobranchs: This group, represented by sharks, skates and rays, is one of the common items of fish caught in shrimp trawls all along the west and east coasts and constitute nearly 5% of the annual landings of by-catches in the country. Out of 15,336 tonnes of elasmobranchs landed during 1979 more than 68% was recorded from Maharashtra and Tamil Nadu alone, forming 10.3% and 6.6% of the by-catches of the respective states. They occur in the trawl nets almost throughout the year, with peak landings during November–March along the coasts of Gujarat, Maharashtra and Kerala and during August–November in Tamil Nadu and Andhra Pradesh. The sharks caught are generally smaller in size as against the huge sizes captured very often in hooks and lines and other indigenous gears. Rays of all sizes upto about 2 m across the disc are encountered and they form the major component of the elasmobranch catch.

Eels: Although not very abundant as other groups, two species of eels namely *Muraenesox talabonoides* and *M. cinereus* are met with very often in the trawl catches of northwest coast and to a limited extent in the east coast. The highest catches are recorded in Maharashtra where they accounted for 5.4% of the

Table 4. *Monthwise landings of shrimp by-catches in different maritime states during* 1979

Maritime States	Catch in tonnes												
	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Gujarat	11,729	6,445	12,431	8,391	515	57	21	11	16,938	2,615	4,284	6,834	70,271
Maharashtra	8,132	6,590	5,254	5,397	4,764	1,245	623	770	2,764	5,106	3,880	4,263	48,788
Goa	527	432	1,602	814	398	15	18	11	72	233	890	1,481	6,493
Karnataka	3,557	1,604	5,403	2,895	2,259	135	—	—	437	697	59	1,111	18,157
Kerala	3,119	2,393	3,742	3,791	4,793	1,574	6,275	13,503	7,227	2,954	2,554	3,027	54,952
Tamil Nadu	5,464	8,971	9,152	7,086	4,799	9,662	5,516	6,498	4,671	8,117	7,468	6,092	83,496
Pondicherry	33	192	173	278	123	397	405	542	445	307	95	168	3,158
Andhra Pradesh	1,419	1,159	1,624	1,051	959	742	1,864	1,835	6,421	3,757	1,401	1,080	23,312
Orissa (Monthly figures not available)	—	—	—	—	—	—	—	—	—	—	—	—	7,275
ALL INDIA	33,980	27,786	39,381	29,703	18,610	13,827	14,722	23,170	38,975	23,786	20,631	24,056	3,15,902

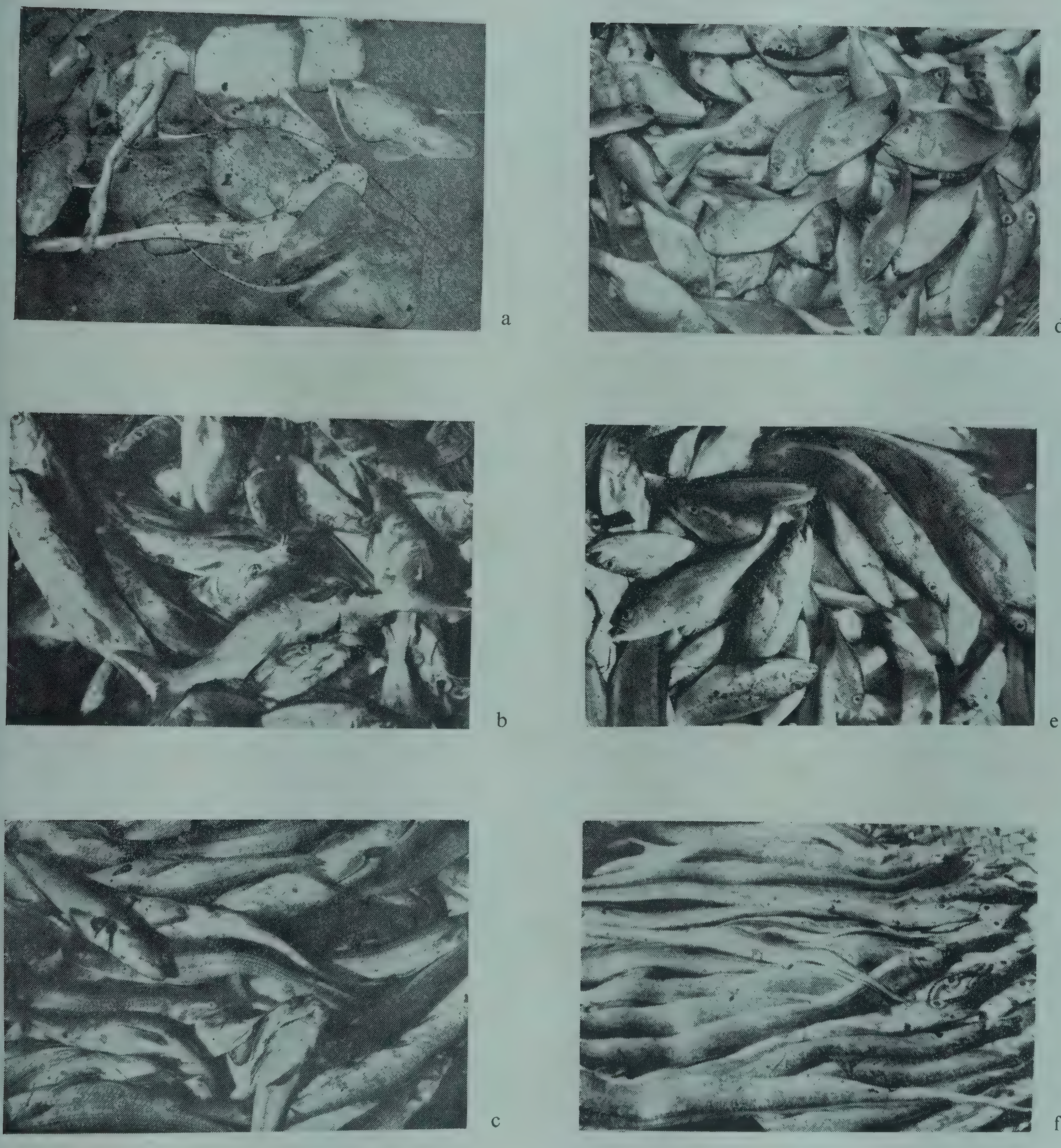


Fig. 1. Dominant fishes in by–catches
a – Elasmobranchs, b – Catfish,
c – Lizard fish, d – *Nemipterus japonicus*,
e – Sciaenids, f – Ribbon fish

Fig. 2. Dominant fishes and other groups in by-catches

a – *Lactarius* sp. and *Leiognathus* sp.,
b – Soles, c – Crabs, d – Stomatopods,
e – Squids and cuttle fish,
f – Assorted collection of fishes.

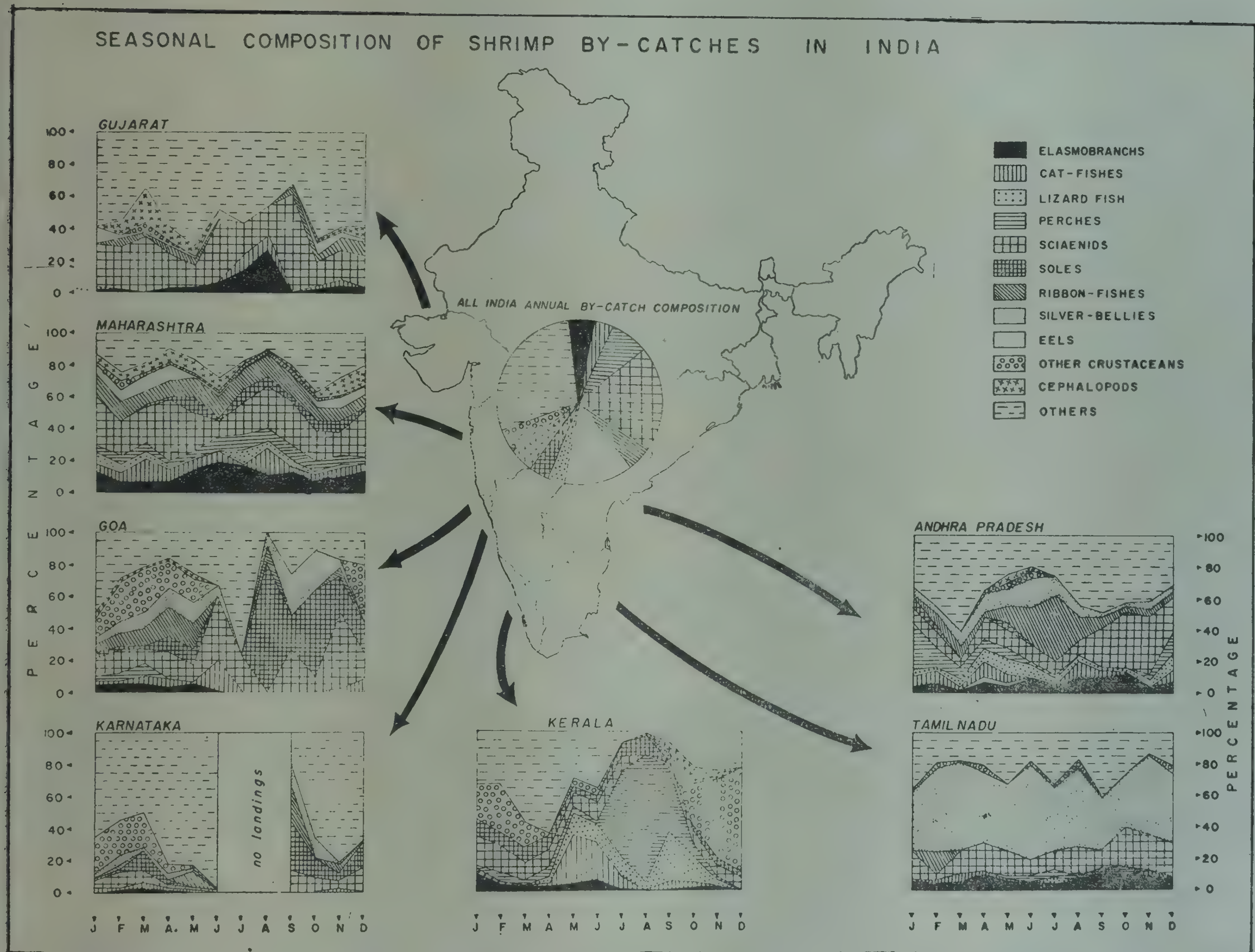


Fig. 3. Distribution pattern of major categories in the shrimp trawler landings of maritime states during 1979.

Table 5. *Landings (in tonnes) of important categories of by-catches by commercial shrimp trawlers in different maritime states during* 1979
(Figures in parenthesis are individual percentages in the total by-catch)

Categories	Maritime States									All India total
	Gujarat	Maharashtra	Goa	Karnataka	Kerala	Tamil Nadu	Pondicherry	Andhra Pradesh	Orissa	
Elasmobranchs	1,095 (1.6)	5,054 (10.3)	170 (2.7)	153 (0.9)	1,202 (2.2)	5,470 (6.6)	87 (2.8)	1,694 (7.3)	411 (5.6)	15,336 (4.85)
Eels	1,973 (2.8)	2,613 (5.4)	—	—	1	35	8 (0.3)	187 (0.8)	—	4,817 (1.52)
Catfishes	538 (0.8)	3,059 (6.3)	276 (4.3)	506 (2.8)	2,778 (5.1)	1,215 (1.5)	27 (0.9)	734 (3.1)	597 (8.2)	9,730 (3.08)
Dorab	335 (0.5)	84 (0.2)	7 (0.1)	—	10	86 (0.1)	4 (0.1)	19 (0.1)	—	545 (0.17)
Lizard fish	100 (0.1)	1,973 (4.0)	102 (1.6)	57 (0.3)	5,238 (9.5)	1,130 (1.4)	247 (7.8)	887 (3.8)	—	9,734 (3.08)
Perches	497 (0.7)	2,598 (5.3)	169 (2.6)	34 (0.2)	18,195 (31.1)	2,016 (2.4)	895 (28.3)	1,151 (4.9)	82 (1.2)	25,637 (8.12)
Polynemids	9	1,240 (2.5)	—	—	25	358 (0.4)	—	191 (0.8)	658 (9.0)	2,481 (0.78)
Sciaenids	24,310 (34.3)	12,738 (26.1)	1,208 (18.9)	1,074 (5.9)	3,875 (7.1)	13,031 (15.6)	198 (6.3)	4,729 (20.3)	4,853 (66.7)	66,016 (20.90)
Ribbon fishes	2,968 (4.2)	5,210 (10.7)	487 (7.6)	507 (2.8)	813 (1.5)	1,491 (1.8)	64 (2.0)	2,268 (9.7)	248 (3.4)	14,056 (4.45)
Carangids	89 (0.1)	721 (1.5)	151 (2.4)	44 (0.2)	247 (0.4)	421 (0.5)	33 (1.1)	1,023 (4.4)	—	2,729 (0.86)
Silver bellies	—	96 (0.2)	484 (7.6)	609 (3.4)	1,003 (1.8)	39,517 (47.3)	579 (18.3)	1,440 (6.2)	—	43,728 (13.84)
White fish	751 (1.1)	369 (0.8)	247 (3.9)	78 (0.4)	26	631 (0.8)	10 (0.3)	116 (0.5)	—	2,228 (0.71)
Pomfrets	362 (0.5)	317 (0.7)	33 (0.5)	18 (0.1)	92 (0.2)	128 (0.2)	6 (0.2)	122 (0.5)	57 (0.8)	1,135 (0.36)
Barracudas	—	39 (0.1)	—	18 (0.1)	22	69 (0.1)	14 (0.5)	15 (0.1)	—	177 (0.06)
Soles	332 (0.5)	1,455 (3.0)	797 (12.5)	1,157 (6.4)	3,855 (7.0)	1,892 (2.3)	131 (4.1)	577 (2.5)	99 (1.4)	10,295 (3.26)
Other crustaceans	939 (1.3)	880 (1.8)	1,315 (20.6)	2,459 (13.5)	7,384 (13.4)	2,290 (2.7)	98 (3.1)	352 (1.5)	—	15,717 (4.98)
Cephalopods	4,824 (6.9)	3,104 (6.4)	73 (1.1)	41 (0.2)	1,536 (2.8)	837 (1.0)	39 (1.2)	474 (2.0)	—	10,928 (3.46)
Miscellaneous	31,149 (44.2)	7,238 (14.7)	974 (15.2)	11,402 (62.8)	8,650 (15.7)	12,879 (15.4)	718 (22.7)	7,333 (31.5)	270 (3.7)	80,613 (25.52)
TOTAL	70,271	48,788	6,493	18,157	54,952	83,496	3,158	23,312	7,275	3,15,902

total by-catches during 1979. Among the two species mentioned above *M. talabonoides* (Wam) is the most common and measures a maximum of about 2 m in total length.

Cat fishes: The catfishes form one of the common elements of the by-catches all along the Indian coasts and contribute to about 3% of the total landings. Maximum catches are recorded from Maharashtra and Kerala where they are caught throughout the year with peak abundance during the summer period (March–May). The cat fishes obtained in shrimp trawls

include a large number of species mostly of the genus *Tachysurus* and are generally represented in the size range 15–75 cm.

Dorabs: The dorabs or wolf herrings *(Chirocentrus dorab* and *C. nudus)* occur rarely in the trawl catches. In Gujarat they are encountered almost regularly from November onwards till the onset of monsoon.

Lizard fish: Contributing to about 3% of the total by-catches the lizard fish *Saurida tumbil* and allied forms constitute an important item of the catch landed in Kerala with peak abundance during the monsoon period. In other states like Maharashtra, Tamil Nadu and Andhra Pradesh also fair quantities are recorded occasionally during the non–monsoon periods. The common size range is about 15–40 cm.

Perches: The occurrence of several varieties of small and medium sized perches in shrimp trawls is a regular feature throughout the west and east coasts. *Nemipterus japonicus* (Kilimeen in Malayalam) is the most common species caught in Kerala where this group forms the largest component of the by-catches (31.1%) landed. Its peak abundance is observed during the southwest monsoon period. Other common perches are species of *Pomadasys, Lutjanus, Gerres, Kurtus, Sillago, Drepane* and *Therapon*. *P. hasta* locally known as "Karkara" is a highly sought-after species occurring more frequently in Bombay-Saurashtra waters.

Polynemids: The thread fins contribute to the by-catches in minor quantities in Maharashtra, Tamil Nadu, Andhra Pradesh and Orissa. In Bombay waters they form a sizable portion of the catch and are chiefly represented by two species namely *Polynemus heptadactylus* (Shende) and *P. indicus* (Dara), the former growing upto about 30 cm and the latter 140 cm in total length.

Sciaenids: Of all the by-catch categories, sciaenids, popularly known as 'Jewfishes', are the most common and are represented by various sizes upto about 120 cm. In 1979 they accounted for nearly 21% of the total by-catches of the country ranking first among the categories. The bulk of the landings was contributed by Gujarat and Maharashtra where the catch consists of two large growing species namely *Pseudosciaena diacanthus* (Ghol) and *Otolithoides brunneus* (Koth) and a number of smaller species collectively known as 'Dhoma' belonging to the genera *Johnius, Otolithus* and *Sciaena*. Substantial quantities of sciaenids are also landed in Tamil Nadu and other neighbouring areas of the east coast.

Ribbon fishes: They occur in moderate quantities all along the Indian coast contributing to nearly 5% of the total by-catches. Maximum landings are recorded in Gujarat and Maharashtra.

Carangids: Several species of *Caranx* and allied forms are often encountered in shrimp trawls as minor catches all along the west and east coasts. The carangids thus caught are generally smaller in size rarely exceeding 30 cm. They are relatively more common on the east coast where peak landings are recorded during the first quarter of the year.

Silver bellies: This is the second dominant item of the by-catches and contributes to about 14% of the annual landings. Out of 43,728 tonnes landed during 1979 nearly 90% was caught from Tamil Nadu coast alone. A number of species of the genus *Leiognathus* and a single species of *Gazza (G. minuta)* comprise the silver bellies catch, the former group being the most dominant. In Tamil Nadu the silver bellies are caught in trawl nets throught the year, the maximum catches being recorded from February to May.

White fish: The white fish *Lactarius lactarius* is one of the quality fishes caught in trawls occasionally. It is more common in the northwest coast and Tamil Nadu where the catch is generally represented by small and medium sized fish measuring 5–15 cm length.

Pomfrets: Like the white fish, pomfrets are also quality fishes occurring all along the Indian coasts but generally as stray numbers in the by-catches. In Bombay-Saurashtra coast, however, they are caught quite often in fair quantities and are represented by three types, of which the brown-pomfret *(Parastromateus niger)* and silver pomfret *(Pampus argenteus)* are dominant. The former species grows to fairly large size, with the sizes ranging from 10 to 30 cm.

Barracudas: One of the less common groups of by-catches, the barracudas are represented by a few species of *Sphyraena*.

Soles: The soles and other flat fishes form a regular component of the trawler landings throughout the Indian coasts and contribute to about 3% of the annual by-catch production. Maximum quantity is landed in Kerala. Except for a few large growing species

like the Indian halibut *Psettodes erumei* (Aayirampalli in Malayalam) and the large "tongue soles" *Cynoglossus dubius* and others caught occasionally, the bulk of the catch is constituted by the smaller species *C. semifaciatus* popularly known as Malabar sole. The usual size range is about 8–15 cm. At Neendakara in Kerala they are caught almost throughout the year with peak landings during the monsoon period.

Other crustaceans: Besides shrimps, the trawlers land considerable quantities of other crustaceans also as by-catches amounting to about 5%. Crabs and stomatopods are the most common and they occur in more or less equal proportions in the total catch. In 1979 nearly 50% of these items were landed in Kerala, followed by substantial quantities in Karnataka and Tamil Nadu. The crabs are predominantly represented by *Portunus pelagicus* and *P. sanguinolentus* and the stomatopods by a single species namely *Oratosquilla nepa*. Peak landings are observed during November–February along the west coast and May–October on the east coast. The spiny lobster *Panulirus polyphagus* is another important crustacean by-catch landed on Maharashtra and Gujarat coasts. Similarly, the deep-sea spiny lobster *Puerulus sewelli* has been trawled in considerable quantities along with shrimps from 250–400 m depth off Kerala coast.

Cephalopods: The cephalopods represented by squids and cuttle fishes contribute nearly 4% of the total by-catches of the country. Out of 10,928 tonnes landed in 1979 over 73% was obtained in Maharashtra and Gujarat. November–May is the period when maximum catch is landed. In Kerala also substantial quantities are landed particularly during August to November. *Loligo duvaucelii, Sepia pharaonis, S. aculeata* and *Sepiella inermis* are the common species, the former three being mostly represented by the size group 10–25 cm and the other by 5–10 cm in mantle length.

Miscellaneous: In addition, several species of trash fishes, both demersal as well as mesopelagic forms, are landed regularly at all centres of the coast. In the overall by-catch landings they collectively account for about 25%.

Utilisation of by-catch

Handling, collection and preservation (Figs. 14-19).

Most of the smaller type of mechanised fishing vessels while going for fishing take ice on board and the larger types of vessels have refrigerated fish holds in them. The catches on the decks of the trawlers are sorted into shrimps and fish by-catch. They are then handled separately and brought to shore, iced in the smaller vessels and frozen in the larger type of vessels. In some of the very small sized vessels fish by-catch is brought to the landing centres in un-iced condition. After landing, the fish is usually packed in bamboo baskets or plywood boxes with sufficient quantity of ice and taken in either lorries, carrier launches, refrigerated or insulated trucks, head loads or cycles to processing plants and to nearby or interior markets.

Table 6. *Common size range of important categories of by-catch*

Categories	Size range (cm)
Elasmobranchs	30–100
Eels	75–150
Dorabs	20–100
Cat fishes	15– 75
Lizard fish	15– 40
Perches	10–150
Polynemids	8–100
Sciaenids	10–120
Ribbon fishes	20– 80
Carangids	5– 30
Silver bellies	5– 15
White fish	5– 15
Barracudas	15– 80
Pomfrets	10– 30
Soles	8– 35
Crabs & Stomatopods	5– 13
Lobsters	10– 30
Squids & Cuttle fish	5– 25

Experiments conducted at Central Institute of Fisheries Technology has shown that the shelf-life of small fishes is considerably enhanced when packed in ice in 1:1 fish to ice ratio. The efficiency of bamboo baskets can be greatly improved by giving them an additional insulated lining with bitumen coated kraft paper. Plywood boxes lined with 25 mm thermocole is found to be very efficient, enabling fish to be stored without spoilage upto nearly 50 hours.

Processing of by-catch

While part of the fish by-catch is disposed in fresh condition in local markets, some of the larger varieties of fish are processed by freezing and filleting. Freez-

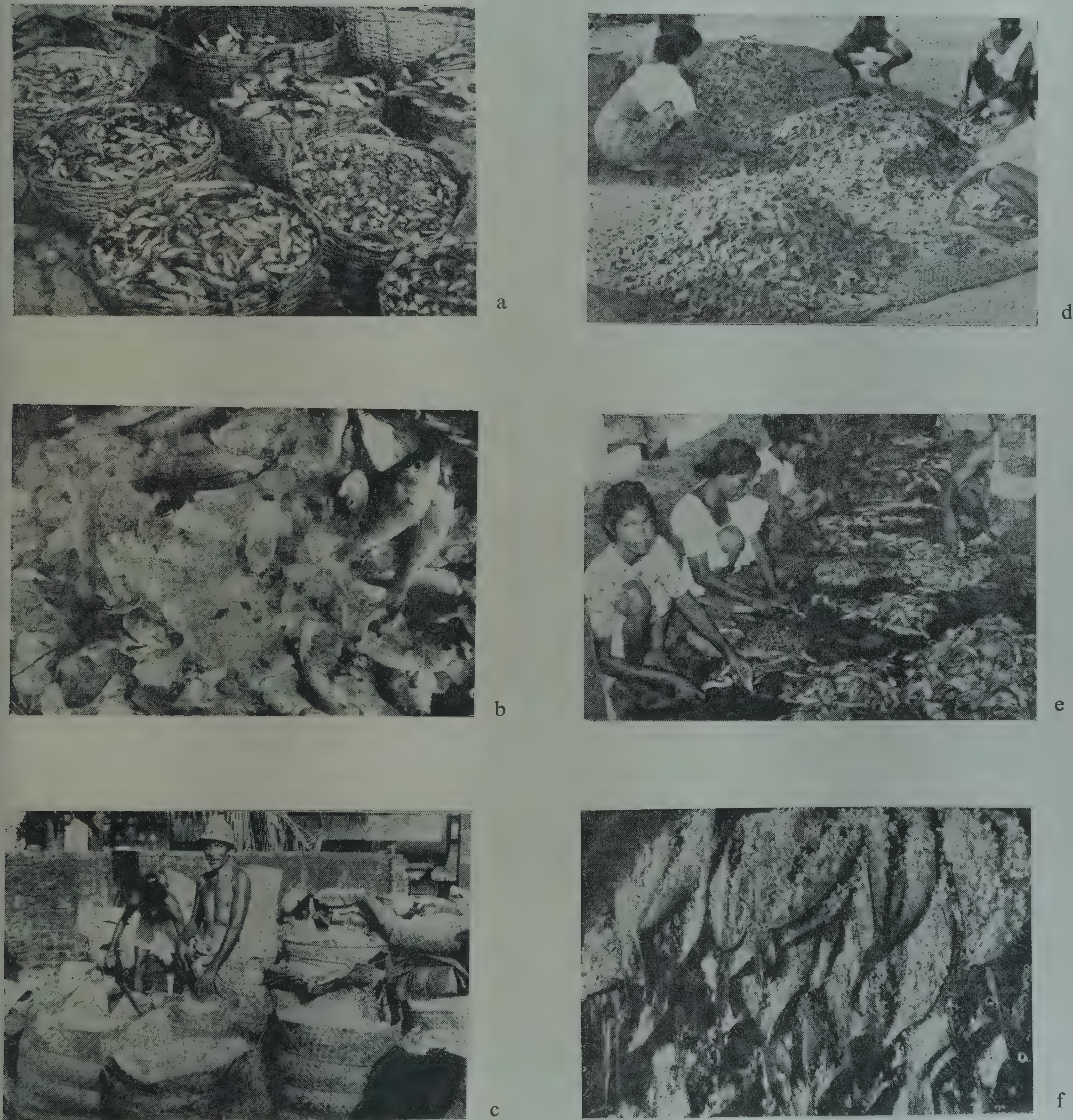


Fig. 4. Utilisation of by-catches

a – Baskets of fishes ready for marketing
b – Iced fish, c – Iced fish being packed
d – Sundrying of soles
e – Preparation for curing
f – Salted fish

ing is now the most important processing method in the country. In 1979, 24,126 tonnes of fresh frozen fish valued at Rs. 1,15,581 was exported in addition to the frozen shrimp products. Of course this would include the products contributed by the pelagic fishes also. Besides, frozen cuttle fish and fillets to the tune of 1,339 tonnes (value Rs. 35,310) from the by-catch was exported.

On account of the improved methods of transportation and marketing introduced in the country frozen fish and fish fillets have picked up considerable sales in many urban areas.

Fish curing methods

The cured and dehydrated products are widely produced because the technology involved is cheap. At present nearly 20% of the fish by-catch is processed in these methods.

Sun drying: Some of the smaller varieties landed are sundried for internal consumption as well as export, mostly prevalent in Kerala, Maharashtra and other maritime states. This is by far the cheapest method of curing fish. Mostly *Lactarius* sp., Bombay duck, eels, soles etc. are dried in this way.

Dry salted fish: This also is a very common method used for curing fish in the country. A wide range of fish to salt ratio is used depending on the size of the fish. 1:1 to 1:6 ratio of fish to salt is used for larger fishes and 1:8 to 1:10 ratio for smaller fishes.

Wet curing: In this method salt is applied in three instalments. Fish is dressed and eviscerated. Fifty per cent of the total salt is applied on all cut surface and the fish is stacked on the vessels. The other 50 per cent salt is added in two instalments in subsequent two days and the self-brine is allowed to drain. The fish is sold without further drying. The yield is 70.4% and has a shelf-life upto three weeks.

Pit curing: The fish is treated with the requisite quantity of salt and buried in pits lined with certain types of mattings over the sides, top and bottom. It is then covered with sand and trampled down to exert pressure. After two days the fish is taken out and marketed without further processing. The yield is 69.4% and has a shelf-life of approximately three weeks.

Colombo curing: This method has been in vogue in South Kanara region and Malabar coast of Kerala. The dressed fish is salted in the ratio 1:3 or 1:4 and a small quantity of Malabar tamarind is placed in the belly cavity of the fish. The fish is then arranged in barrels with intermittent layers of salt and Malabar tamarind (50 gm/Kg of fish). The yield is about 75.0% and has a shelf-life upto 6 months.

Products of by-catch

Under an all India Co-ordinated Research Project on transportation of fresh fish and utilization of trash fish carried out in the Central Institute of Fisheries Technology during 1971 through 1979 several products were prepared and developed, some of which have been recommended for pilot scale and large scale production.

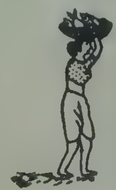
Fish Protein Concentrate (FPC) was prepared from different species of trash fishes obtained in the by-catch and its storage life and analytical characteristics were determined. A pilot plant for production of FPC has been installed. Bacteriological peptone from threadfin bream, found to be of high quality, was put to commercial production for use as a growth supporting compound in microbiological media formulations.

Fish hydrolysates, fish soup powder, fish flakes, edible fish powder, fish fingers and canned pet food from cheap miscellaneous trash fish were some of the products for which methods of preparations were standardised. A large number of speciality products like fish paste, fish sausages, fish pappads, fish wafers, fish spirals, fish seva, fish diamond cuts, fish jam, fish noodles and canned fish paste products also have been developed and their consumer acceptability determined. A method for the preparation of fish silage (poultry and animal feed) from cheaper varieties of fish was standardised. Improved methods of sun drying, wet and dry curing and smoking were also developed.

Conclusion

The present study makes it clear that nothing much from the shrimp trawler catches is wasted in India and almost all the fishes, which are termed trash fish and discarded over board the vessel in some of the developed countries, are utilised either for human consumption

or as fish meal and fish manure. However it is to be pointed out that the handling, processing and utilisation of the fish catches, which form more than three fourths of the total landings, need further improvement. Streamlining of the handling, preservation, transport and marketing systems with the aim of proper and maximum utilisation of the valuable protein resources is essential.



NEWS—INDIA AND OVERSEAS

Lloyd's approval for Indian engine

The Kirloskar Cummins Ltd., at Kothrud, Poona, India is the first in Asia - excluding Japan - to be approved for the production of marine oil engines under the Lloyd's Register Batch and Line Production Scheme. Certificate has been issued to the firm and applies to the production of oil engines of approved types. Application of the scheme means that instead of each engine having to be inspected individually when a Lloyd's Register Certificate is required, all engines produced (together with their spare parts) will be eligible for a Lloyd's Register Batch and Line Certificate.

The Lloyd's Register Batch and Line Production Scheme, which has been operating successfully for 10 years, requires a Company's works and quality control procedures to be examined by LR's surveyors in order to verify full compliance with the requirements of the scheme. After approval, the procedures are kept under continuing surveillance by regular visits from LR surveyors to ensure that the approved standards are maintained.

Type specimens in Central Marine Fisheries Research Institute deposited in Zoological Survey of India

Since the inception of the Central Marine Fisheries Research Institute at Mandapam Camp the holotype and paratype specimens of zoological taxa newly described by scientists have been deposited in the research collections of the Institute over the years. As the Zoological Survey of India is the National Repository for type specimens it was decided to transfer all holotypes of Vertebrates and Invertebrates in the CMFRI collections to the National Zoological collections at the Zoological Survey of India, Calcutta. Accordingly these type specimens were recently transferred to the Zoological Survey of India from Mandapam Camp. On 19th December 1980 the specimens were handed over at Mandapam to Dr. K. C. Jayaram, Deputy Director of Zoological Survey of India (photographs) to be transported to Calcutta. The holotype thus re-

registered with the Zoological Survey of India and incorporated into the National Zoological Collections include species belonging to Pisces–12, Crustacea-50,

Mollusca-4, Annelida-3, Echinodermata–1, Chaetognatha-2, Coelenterata-7, Porifera-19, and Protozoa-1, making a total of 99 species.

Titanium for fish processing machinery

Soviet engineers have been testing titanium as a possible substitute for stainless steel in fish processing machinery, where corrosion by seawater and food additives can reduce the working life of machinery and cause loss of working time through breakdowns. Sometimes the product itself gets adversely affected by the corrosion. Results of these tests with titanium have been reported recently.

It seems that there is a startling difference between the corrosion resistance of the two metals. Taking depth of pitting as a measure of susceptibility to corrosion, one year in moving seawater produced a pitting depth of 0.061 mm in stainless steel and a negligible 0.00003 mm in titanium. In still water, over 480 days, stainless steel was pitted to a depth of 0.24 mm while titanium was unaffected. These results were borne out over even longer test periods.

The report states that special training is necessary for welders and others working in this material. No figures are given in terms of comparing high initial cost to low repair/maintenance cost.

World Fishing 29 (2): February 1980

Clams cultured in plastic island

Clams are being grown on lines hanging from an artificial island of floating plastic canisters near Cape Kaliakra, Bulgaria. The canisters are arranged radially from the centre, each radial arm being about 80 m long.

This is Bulgaria's first successful clam farm. Previous attempts failed because the sea was too rough. The island on canisters has survived all storms for more than two years.

Four tonnes of clam meat have been produced in a single crop from the artificial island. Bulgarian fishery officials hope to establish more than 100 similar islands in the sea around Cape Kaliakra.

World Fishing 29 (6): June 1980

Success in breeding tuna in captivity

Japanese researchers have reported that they succeeded in breeding bluefin tuna in captivity for the first time. Bluefin tuna *Thunnus thynnus*, growing to over 500 kg, was reared in pens and eggs laid by them were successfully hatched in rearing tanks.

The breakthrough of hatching bluefin has brought much closer the Japanese dream of culturing highly priced tuna species. Among several institutions currently involved in co-operative tuna culturing programmes, the present experiment had been conducted at Kinki University Fishery Experimental Laboratory at Shirahama. Here the work began in 1970 with the rearing of younger stages of tuna caught in fish traps in holding pens, 30 m in diameter and 7 m deep set in waters off Kushimoto. They hold some 4500 tuna of various sizes including 60 fish which have lived for a record five years in captivity and weigh about 100 kg. The males among these five year old fish were observed to pursue the females in early June last year. After a few days about 2,10,000 eggs were collected. These eggs were transferred to hatching tanks with water temperature maintained at between 22 and 24°C and they began hatching within a day. Algae *Clorella* extracts and oxygen were fed into the tanks. The larvae grew 4 mm in the first four days. The researchers are planning to rear the larvae through to maturity.

World Fishing 29 (6): June 1980

Skipjack tuna also have been spawned in captivity for the first time at the National Marine Fisheries Service's Honolulu Laboratory. Here more than 1,00,000 eggs were stripped from the ovaries of two females and fertilized with milt from two males. Many of the larvae produced from this spawning were alive and feeding actively ten days later. The rearing of the larvae is in progress under the leadership of Dr. Thomas Kazama. Planktonic food cultured in the laboratory is being used in the rearing experiments.

FNI 19 (10): October 1980

Heavy mortality of crabs in Taiwan

The worst drought in more than 50 years has hit crab farmers in Taiwan. The weather has been disastrous, causing serious losses to the farmers. Fishery experts are still investigating the causes for the large scale mortality of the crabs.

Among other problems brought out by the unusually hot dry weather has been a drastic increase in water salinity. Apparently the crabs cannot adjust to the increased salinity of the water, especially during their moulting stages, and have been dying in large numbers. Some areas have reported more than 80 per cent mortality.

FNI 19 (10): October 1980

Shrimp culture catching up in Latin America

FAO Market Information Service for Fish Products reports about the rapid development of shrimp farming in Latin American countries. Ecuador is leading in this development with more than 40,000 acres of ponds. Panama has about 1,600 acres and shrimp culture ponds are being constructed in Columbia, Costa Rica, Honduras, Peru and Nicaragua.

Feasibility studies for shrimp culture are underway in Brazil, Martinique, French Guiana, Mexico and Venezuela. According to the FAO Service Ecuador has the world's largest shrimp culture industry.

FNI 19 (10): October 1980

BOOKS

Fjord Oceanography: Edited by Howard J. Freeland, David M Farmer and Colin D. Legings, Plenum Press, New York, pp 715, 1980.

The papers contained in this volume were presented at a workshop funded by the NATO Advanced Studies Institute in Victoria, British Columbia.

This book presents an unusually broad summary of the present state of knowledge of this class of inlets. The volume considers physical problems ranging from the mathematical theory of circulation to engineering aspects of intentional and unintentional changes in oceanography. The ecology of Fjords is examined in detail, with emphasis on the effects of changes in the physical and chemical environment. Responses to natural and man-made changes particularly pollution, are considered at length. Reviews are presented that define the problems and give an overview of the present state of knowledge, and individual case studies of Fjords are presented that describe in detail the physical and chemical changes and the resulting ecological responses.

Ocean Dumping and Marine Pollution: Edited by Harold D. Palmer and M. Grant Gross, Dowden, Hutchinson & Ross, Inc. Pennsylvania, pp 268, 1979.

Majority of the papers from this volume were presented in a Symposium during the 51st Annual Meeting of the Society of Economic Paleontologists and Mineralogists in Washington, D.C., in June 1977. The contributors for this volume represent a variety of institutions, agencies, and private firms involved in the study of the fate of wastes dumped at sea. By way of an introduction, the editors have attempted to set the theme in a brief review of the source of materials dumped at sea, their fates and some statistics on volumes and the nature of wastes, direct observations of materials other than dredged spoils are also included in this volume.

Ecological Processes in coastal and Marine Systems: Edited by Robert J. Livingston, Plenum Press, New York, pp. 560, 1979.

This volume comprehensively examines interactions between estuaries – coastal ecosystems and contiguous continental shelf areas. Offering new approaches to marine ecological research, the volume reviews and synthesizes current knowledge. The contributors focus on the coupling of physicochemical and biological phenomena, energy transfer mechanisms, and the community structure of diverse marine assemblages. The movement and distribution of populations, including life history progressions, are covered as well. Special attention is given to spatial and temporal variability and the source and nature of energy flow in these highly productive systems. Controlling and interacting functions and the effects of pollutions are also emphasized.

Compiled and prepared by Dr. M. J. George and G. Subbaraju. Published by Dr. M. J. George, Senior Scientist on behalf of the Director, Central Marine Fisheries Research Institute, Cochin-682 018 and printed at PAICO, Cochin-31.

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No. 29

JULY 1981

THE MARINE FISHERIES INFORMATION SERVICE: Technical and Extension Series envisages the rapid dissemination of information on marine and brackish water fishery resources and allied data available with the Fishery Data Centre and the Research Divisions of the Institute, results of proven researches for transfer of technology to the fish farmers and industry and of other relevant information needed for Research and Development efforts in the marine fisheries sector.

Abbreviation – *Mar. Fish. Infor. Serv. T & E Ser., No.* 29: 1981

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2. News — India and overseas

Cover photo: Sakthikulangara mechanised vessel landing centre.

IMPACT OF MECHANISED FISHING ON THE SOCIO-ECONOMIC CONDITIONS OF THE FISHERMEN OF SAKTHIKULANGARA-NEENDAKARA, KERALA*

Introduction

In recent years Sakthikulangara–Neendakara area has gained considerable importance as a major centre of fishing industry in Kerala State. This has been brought about by the introduction of a large number of mechanised trawlers and consequent development of infrastructure facilities like ice factories, freezing cum cold storage plants and boat building yards. The villages of Sakthikulangara and Neendakara are situated 9 km north of Quilon on the banks of Ashtamudi channel which connects Ashtamudi lake with the sea. Mechanised boats were first introduced in this area in the mid fifties under the auspices of the Indo-Norwegian Project and over the years there has been a spectacular growth in the fishing activities of this area.

Studies on the socio economic conditions of the fishermen of this area with reference to housing, health and sanitary conditions, income levels of fishermen etc. were carried out by the Indo-Norwegian Project authorities during the fifties and sixties after the commencement of the project (H. Lid and A. Bassen, 1957, Indo-Norwegian Project in Travancore-Cochin, Report No. 3; Asari T.R.T. and M.D. Menon, 1963, A report on the assessment of the Indo-Norwegian Project on the socio economic conditions of the fishermen of the area). It is observed from these reports that in the fifties the standard of living of the fishermen of this area was very low, showing considerable improvement in the sixties consequent to the introduction of mechanisation in fishing.

Great strides have since been made in the socio-economic conditions of these fishermen and it was felt desirable to carry out a study of the same in order to assess the progress made in recent years so as to form a base for further planning of developmental programmes. Accordingly a survey was carried out in this area during March–May 1980 details of which are presented here.

*Prepared by R. Sathiadhas and G. Venkataraman, CMFRI, Cochin

Work programme

A preliminary investigation was conducted to identify the wards of the Sakthikulangara and Neendakara panchayats predominantly resided by fishermen and the type of data to be collected from the fishermen households. Based on this investigation, two types of schedules for data collection were prepared, one being household schedule and the other village schedule. The household schedule contained particulars relating to the family details of the fishermen such as size of the family, literacy, number of persons engaged in fishing and fishery related and other activities, number of crafts and gears possessed and their income. Information pertaining to the infrastructure facilities available in the area like cold storage cum freezing plants, ice plants, boat building cum repairing yards and peeling sheds was collected in the village schedule.

The definition of terminologies followed in the collection of data is given below:

1. *Fishermen household:* Any household wherein at least one member of the family is engaged either in fishing or fishery related activities has been considered as a fishermen household for the present study.

2. *Types of houses:*

a) Hut: A dwelling with thatched roof and having either a mud wall or an enclosure made of *thattis*.

b) Kutcha house: A dwelling with a thatched roof and brick wall.

c) Pucca house: A dwelling with tiled roof and brick wall.

d) Mansion: A dwelling having concrete roof.

3. *Educational status:*

a) Primary: Those who have passed 5th standard.

b) Middle: Those who have passed 8th standard.

c) Secondary: Those who have passed 10th standard.

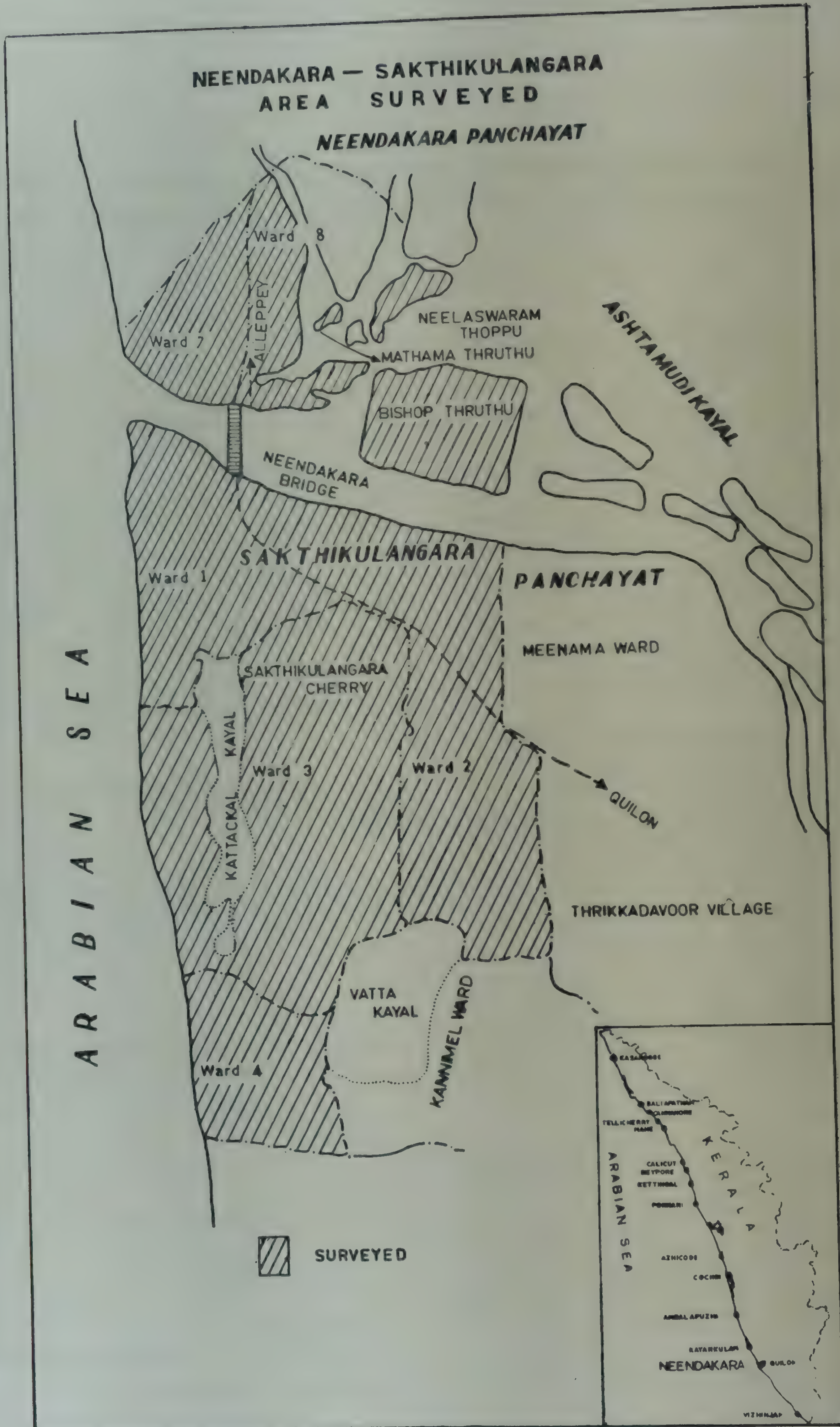


Fig. 1. Map showing the areas included in the socio-economic survey.

d) Higher secondary and above: Those who have passed secondary and taken to higher courses.

4. *Major occupation:* Occupation which brings more than 50% of the households' income.

5. *Work force:* Persons available for employment excluding children below 12 years, those above 60 years and students.

6. *Fishery related activities:* Those who are engaged in activities like fish trading, net making/repairing, curing and processing and boat building/repairing come under this category.

Out of the 12 wards included in the Sakthikulangara panchayat, 4 wards and out of the 8 wards in Neendakara panchayat, 2 wards were selected for conducting the socio-economic survey as these wards are predominantly occupied by fishermen and constituted Sakthikulangara and Neendakara villages respectively (Fig. 1).

Two persons were engaged for conducting door to door enumeration of the fishermen households on a whole time basis for a period of two months from 3–3–1980 to 2–5–1980. The scientific staff of the Central Marine Fisheries Research Institute associated with this work camped there during this period and personally supervised the work of the enumerators. They also conducted spot checking to ensure the accuracy of the data collected.

Details of socio-economic survey

a) Population

The total number of households in the 4 wards of Sakthikulangara and 2 wards of Neendakara comes to 2,698 of which 1,638 are fishermen households. The total population is 14,499, the fishermen alone being 9,116, forming 63 per cent.

The total number of households in Sakthikulangara comes to 2,103 whereas in Neendakara it is 595. The total population of Sakthikulangara is 11,038 and in Neendakara 3,461, the fishermen population alone being 6,551 in the former and 2,565 in the latter. The maximum number of fishermen population in Sakthikulangara is in D ward and in Neendakara in 7th ward.

It is seen from the analysis of sexwise distribution of the population in the area (Table 2) that the males outnumbered the females, there being 912 females in Sakthikulangara and 963 females in Neendakara for 1000 males. Adults falling in the age group of over 18 constitute 52 per cent whereas children coming below the age of 12 constitute 32 per cent of the population of both the places together, the rest falling in the category of 12–18 years.

Table 1. *Household and population details in Sakthikulangara and Neendakara*

Ward	Total: No. of households	Total: Population	Fishermen alone: No. of households	Fishermen alone: Population
Sakthikulangara –A	415	2,308	357	1,986
Sakthikulangara –B	630	3,044	202	1,032
Sakthikulangara –C	434	2,357	208	1,162
Sakthikulangara –D	624	3,329	442	2,371
Neendakara–7th	340	1,925	252	1,468
Neendakara–8th	255	1,536	177	1,097

b) Size of family

There is no striking difference in the average size of the fishermen and non-fishermen households (6 persons in the former as against 5 in the latter). The size of the fishermen families under different categories in both the areas, is presented in Table 3.

It is interesting to note that 54 per cent of the total households in Sakthikulangara have a family size of 1 to 5 whereas in Neendakara only 48 per cent of the households come under this category. However the percentage of households coming under the category of 6 to 10 members are more or less equal in both the places. But those coming under the category of 10 and above are significantly higher in Neendakara (5 per cent) as compared to Sakthikulangara (1 per cent). This can be due to the joint family system being more in vogue in the former than in the latter.

Table 2. *Agewise and Sexwise distribution of the population*

Age group	Sakthikulangara			Neendakara			Total		
	Males	Females	Total	Males	Females	Total	Males	Females	Total
Below 12	1,776	1,721	3,497	583	579	1,162	2,359	2,300	4,659
12–18	910	892	1,802	283	288	571	1,193	1,180	2,373
Above 18	3,088	2,651	5,739	897	831	1,728	3,985	3,482	7,467
Total	5,774	5,264	11,038	1,763	1,698	3,461	7,537	6,962	14,499

Table 3. *Size of family of fishermen households*

No. of members	No. of households Sakthikulangara	Neendakara
1–5	655	205
6–10	539	201
Above 10	15	23
Total	1,209	429

c) Housing

Huts and Kutcha houses comprise 80% of the dwellings in Neendakara whereas they form 49 per cent in Sakthikulangara (Fig. 2). These huts have very little dwelling space and most of them are ill ventilated. Pucca houses and mansions are found to be more in Sakthikulangara (51 per cent) as compared to Neendakara (20 per cent). Some of the islands forming part of Neendakara area lack electricity and potable water facilities.

d) Literacy

Table 4 gives particulars regarding educational status of the people of the two villages. A majority of the population both in Sakthikulangara (76 per cent) and Neendakara (83 per cent) are literates.

A significant feature noted is that illiterates comprise 24 per cent in Sakthikulangara whereas the same constitute only 17 per cent in Neendakara. However among the literates, 34 per cent come under higher secondary and above in Sakthikulangara in contrast to 28 per cent in Neendakara. This is probably due to the parents of Sakthikulangara being comparatively in a better position to afford higher education for their children than that of Neendakara.

e) Occupational pattern

In Table 5 are given the details regarding the different categories of occupation connected with fishing and the

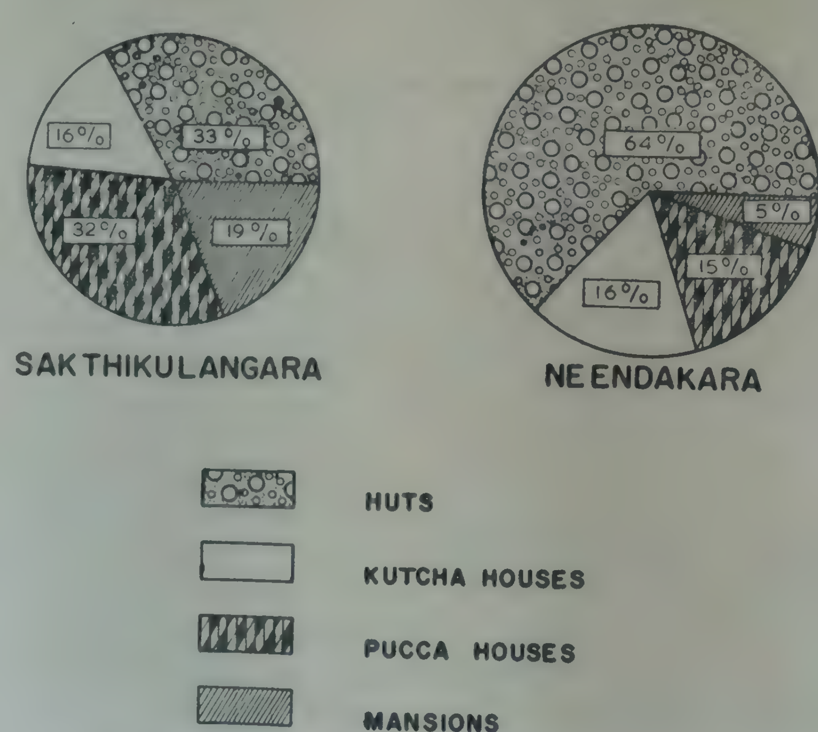


Fig. 2. Proportion of different types of houses in Sakthikulangara and Neendakara.

Table 4. **Literacy among the Fishermen of Sakthikulangara and Neendakara*

Literacy level	Sakthikulangara	Neendakara	Total
Illiterates	1,466	337	1,803
Primary	2,047	801	2,848
Middle	935	419	1,354
Higher Secondary	1,328	376	1,704
Above Higher Secondary	221	95	316
Total	5,997	2,028	8,025

*Those in the age of 5 and above only have been taken into consideration.

number of households coming under each category. Each household is classified under a particular category based on the major source of income.

In Sakthikulangara 30 per cent of the households derive their major income by serving as labourers either in mechanised boats or country crafts. About 20 per cent of the households derive a greater part of their income by the operation of self owned mechanised boats and another 20 per cent by fish trading. About 9 per cent and 8 per cent of the households get their major income by processing and by operating self owned country crafts respectively.

In Neendakara, 46 per cent of the households get their major income by serving as labourers either in mechanised vessels or country crafts. It is interesting to note that a much higher percentage of households in Neendakara (20 per cent) are depending for their major income on the operation of self-owned country crafts as compared with that of Sakthikulangara. The households depending upon other related activities like net making, boat repairing etc. form 14 per cent in Sakthikulangara as against 7 per cent in Neendakara. Only 3 per cent of households in Neendakara get their major income by curing and processing.

f) Employment status

Out of a total fishermen population of 9,116 in the two villages, 2,473 persons are employed, of which 2,219 (90 per cent) are connected with fishing and fishery related activities. The ratio between earning members and the dependents is approximately 1:4. Out of the total work force of 3,008 available in this area it is found that 18 per cent are unemployed. However, a comparison between Neendakara and Sakthikulangara shows that a greater percentage of the work force (25 per cent) is unemployed in the former place as compared with the latter (11 per cent).

It is observed that out of those employed as much as 60 per cent have fishing as their occupation. An interesting feature observed in Sakthikulangara is that among those engaged in fishing as much as 72 per cent are employed in mechanised boats, whereas the same in

Table 5. *Occupational pattern of households*

S. No.	Occupational pattern	No. of households		
		Sakthikulangara	Neendakara	Total
1.	Mech. boat owners	237	47	284
2.	Country craft owners	91	87	178
3.	Labourers engaged in fishing	361	197	558
4.	Fish traders	242	57	299
5.	Curers & Processors	111	12	123
6.	Other allied activities	167	29	196
	TOTAL	1,209	429	1,638

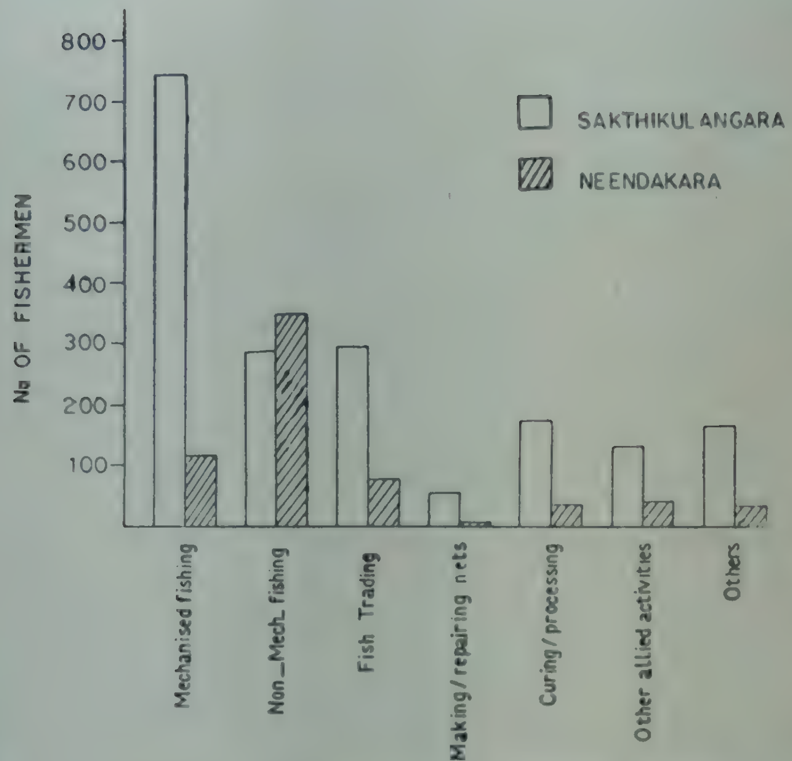


Fig. 3. Employment status of fishermen population in Sakthikulangara and Neendakara.

Neendakara come to only 25 per cent (Fig. 3). In Sakthikulangara, among those employed in fishery related activities, fish traders form the maximum (46 per cent), followed by those engaged in curing and processing (26 per cent). Further 20 per cent of them are employed in activities such as boat building and repairing, freezing, ice making etc. and the rest (8 per cent) are engaged in making/repairing nets. More or less a similar pattern of employment is observed in Neendakara also in respect of fishery related activities. Only a small percentage of people are employed in other sectors like services, business etc. in both the places.

g) *Crafts*

i Details of Crafts

Altogether in this area there are 336 mechanised boats of which 293 are trawlers and 43 gillnetters. Out of these 287 belong to Sakthikulangara, 258 being fully owned and 29 partly owned. Of the 49 boats belonging to Neendakara 39 are fully owned, the rest being shared (Table 6).

The number of non-mechanised crafts (214) is less than the mechanised boats in this area. An interesting feature noted is that the number of plank-built boats are much more in Sakthikulangara than in Neendakara, whereas reverse is the case in respect of catamarans. This shows the higher investment of the people of Sakthikulangara in non-mechanised sector also as compared with that of Neendakara.

ii Ownership

In Sakthikulangara 3 families own 5 or more boats, 5 families own 3 to 4 boats, 193 families have 1 to 2 boats and 36 families have partial ownership (sharing) of boats, whereas in Neendakara 36 families have 1 to 2 boats and 11 families have partial ownership of boats (Fig. 4). 92 families in Sakthikulangara and 105 families in Neendakara own non-mechanised crafts.

It is seen that none of the families in Neendakara own more than two boats whereas 8 families in Sakthikulangara own 3 or more boats. It is also observed that the boats possessed by the people of Neendakara are mostly old and smaller in size as compared with that of Sakthikulangara.

Table 6. *Details of fishing crafts in Sakthikulangara and Neendakara*

Type of craft	Sakthikulangara		Neendakara		
	Owned	Shared	Owned	Shared	Total
1. *Mechanised*					
i) Trawlers	217	27	39	10	293
ii) Gillnetters	41	2	—	—	43
2. *Non-mechanised*					
i) Plank-built boats	52	—	7	—	59
ii) Dug-out boats	40	—	46	—	86
iii) Catamarans	12	—	57	—	69

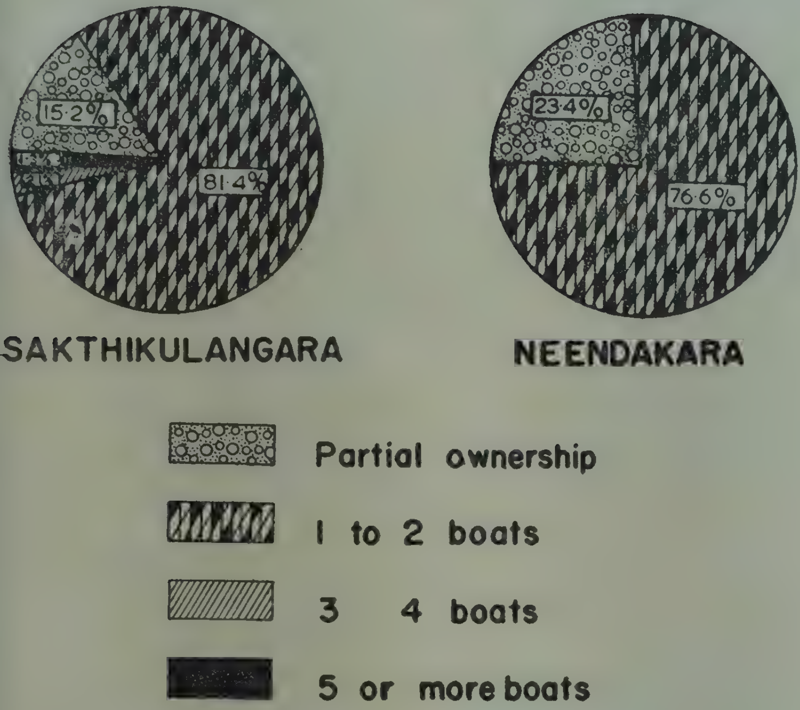


Fig. 4. Family ownership details of mechanised boats in Sakthikulangara and Neendakara.

h) Gears

In Sakthikulangara trawl nets constitute the maximum number followed by gillnets while in Neendakara cast nets form the largest number followed by trawl nets (Table 7). Stake nets form a sizable number in both the places. Hooks and lines occupy an important position in Neendakara.

Table 7. *Fishing gears in Sakthikulangara and Neendakara*

S.No.	Gear	Sakthikulangara	Neendakara
1.	Trawl nets	453	90
2.	Gill nets	305	27
3.	Stake nets	100	52
4.	Cast nets	26	92
5.	Hooks and lines	3	38
6.	Boat seines	—	3
7.	Others	—	11

The process of mechanisation in Neendakara has not obviously been as fast as in Sakthikulangara as reflected in the smaller number of trawl and gill nets. The dependence of the people of Neendakara on non-mechanised fishing is further seen from their possession of sizeable number of cast nets and hooks and lines. Stake nets are found in large numbers in both the places as they are ideally situated on the banks of the Ashtamudi Channel for the operation of the same.

i) Income

There has been significant rise in the level of income of the people of Sakthikulangara and Neendakara in the last two decades. Tables 8 and 9 show the number of families under different income groups based on their major occupation.

In Sakthikulangara about 5 per cent of the fishermen families have a monthly income of Rs. 100/- and below, 37 per cent ranging from Rs. 101/- to 300, 28 per cent ranging from Rs. 301 to 500, 19 per cent ranging from Rs. 501 to Rs. 1,000, 8 per cent ranging from Rs. 1,001 to 2,000, 3 per cent from Rs. 2,001 to 4,000 and 0.5 per cent above Rs. 4,000. In Neendakara 3 per cent of the fishermen families have a monthly income of Rs.100 and below, 58 per cent come under the income range of Rs. 101 to Rs. 300, 29 per cent Rs. 301 to 500, 9 per cent Rs. 501 to Rs. 1,000 and only one per cent under 1,001 to 2,000, there being none above this income range.

Analysis of income levels of the fishermen families according to different categories of occupation has brought out some interesting features. In Sakthikulangara 7 per cent of the families owning mechanised boats have an income ranging from Rs. 301 to 500 and 44 per cent from Rs. 501 to 1,000 per month, there being none having an income of less than Rs. 300. The rest of the families owning mechanised boats come under the higher income brackets ranging from Rs. 1,001 to Rs. 2,000 and Rs. 2,001 and above constituting 30 per cent and 4 per cent respectively. With regard to the families owning non-mechanised boats it is seen that 21 per cent of families come under income range of Rs. 101 to 300 as against nil in the case of families owning mechanised boats, 34 per cent come under the income range of Rs. 301 to 500, 41 per cent under the range of Rs. 501–1,000. Only 3.3 per cent of the families have an income of Rs. 1,001 to 1,500, there being none above this range. About 45 per cent of the families of wage earners by fishing come under the monthly income range of Rs. 101 to 300 and 40 per cent come under Rs. 301 to 500. It is observed that 48 per cent of the families having fish trade as their occupation have an income of less than Rs. 300 per month. Almost all the families carrying out curing and peeling are in lower income levels of less than Rs. 300 per month.

Table 8. *Classification of fishermen families based on occupation and monthly income—Sakthikulangara*

Income group (in Rs.)	Families in different categories						
	Owning mechanised boats	Owning non-mechanised boats	Wage earners by fishing	Fish trading	Labourers doing curing & peeling	Fishery related activities	Total
100 & below	—	1	14	5	27	15	62
101–200	—	9	54	40	62	25	190
201–300	—	10	155	70	19	43	297
301–400	11	14	76	46	3	27	177
401–500	6	17	34	41	—	21	119
501–600	17	11	20	22	—	13	83
601–800	39	14	6	9	—	4	72
801–1,000	48	12	1	7	—	2	70
1,001–1,500	59	3	1	1	—	7	71
1,501–2,000	23	—	—	1	—	2	26
2,001–3,000	19	—	—	—	—	5	24
3,001–4,000	10	—	—	—	—	1	11
4,001–5,000	4	—	—	—	—	—	4
5,001 & above	1	—	—	—	—	2	3

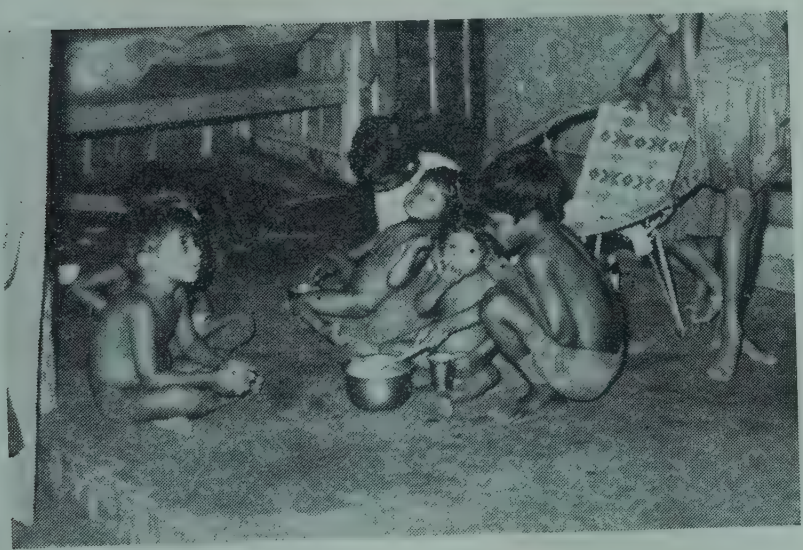
Table 9. *Classification of fishermen families based on occupation and monthly income - Neendakara*

Income group	Families in different categories						
	Owning mechanised boats	Owning non-mechanised boats	Wage earners by fishing	Fish trading	Labourers doing curing and peeling	Fishery related activities	Total
100 & below	—	—	4	—	3	5	12
101–200	—	10	73	24	6	9	122
201–300	—	22	80	12	3	9	126
301–400	9	33	25	12	—	1	80
401–500	8	13	12	6	—	5	44
501–600	12	8	3	3	—	—	26
601–800	13	1	—	—	—	—	14
801–1000	2	—	—	—	—	—	2
1,001–1,500	2	—	—	—	—	—	2
1,501–2,000	1	—	—	—	—	—	1

In Neendakara among the families owning mechanised boats 36 per cent fall under the monthly income range of Rs. 301 to 500, 58 per cent under Rs. 501 to 1,000 and 6 per cent under Rs. 1,001 to 2,000. A majority of the families (53 per cent) possessing nonmechanised boats come under the category of Rs. 301–500, the next highest (37 per cent) falling under the category Rs. 101 to 300. 80 per cent of the families of wage earners by fishing earn an income of only Rs. 300 and less. All the families engaged in curing and peeling, 79 per cent of the families engaged in fishery related activities and 63 per cent engaged in fish trading have a monthly income of less than Rs. 300.

It is seen that the percentage of families having an income of less than Rs. 300 per month are more in

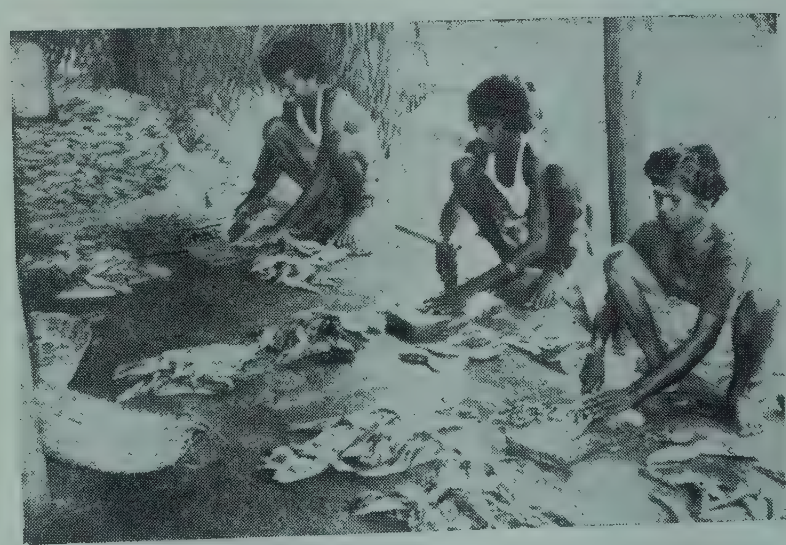
1. A fisherman's hut.



2. Children inside a hut.

3. Cycles waiting to take fish.

4. Inside a peeling shed near the fish landing centre.



5. Fish prepared for curing.

6. Net mending.

7. Catamarans landing their catches.

8. Canoes preparing for fishing trip.

9. Auction of fish at the landing centre.

10. Mechanised boats at the jetty.

11. Unloading of catches from the mechanised boat.

12. Transportation of fish by tempo vans.

Neendakara (61 per cent) than in Sakthikulangara (42 per cent). The percentage of families having an income of Rs. 301–1,000 are more in the latter (47 per cent) as compared with the former (38 per cent). 12 per cent of the families in Sakthikulangara come under the higher income bracket of Rs. 1,000 and above as against only 0.6 per cent in Neendakara.

Fishery related infrastructure facilities

Most of the boats fishing in the area land their catches at privately owned jetties and platforms situated on the Sakthikulangara side of the channel. There are about 23 wooden jetties and one concrete jetty at this centre. The mechanised boats operating from this centre draw mostly their diesel, engine and lubricating oil requirements from the 10 marine diesel bunks situated on the shore side of Sakthikulangara. In this area there are 16 freezing cum cold storage plants. The capacity of the freezing plants range from 1 to 21 tonnes per day adding to a total of 75 tonnes for 24 hours. The cold-storage capacity ranges from 30 to 180 tonnes, making a total of 1,330 tonnes. There is only one canning plant in this area with a capacity of 1.5 tonnes per day. There are 32 ice plants in Sakthikulangara–Neendakara area having capacities ranging from 7 to 40 tonnes with a total production capacity of 350 tonnes per day. All the plants do not work throughout the year as there is lack of demand for ice in the lean season. However, during the peak season the entire capacity is utilized by the fishing industry. Some of the ice factories are attached with the freezing plants. There are about 159 peeling sheds located in the surveyed area. The total quantity of prawns that could be peeled in these sheds is about 75 tonnes per day. There are 10 boat building cum repairing yards, 11 marine engineering workshops and 8 marine spare parts shops located in this area.

The total number of workers in these subsidiary industries are about 3,000 comprising 2,332 engaged in the peeling sheds, 320 in freezing cum cold storage plants, 125 in ice factories, 55 in net making/repairing and the rest in other allied industries. This work force is drawn not only from Sakthikulangara/Neendakara but also from adjoining places.

Boats and fuel requirements

The boats in the first two categories, falling less than 30 ft. length, are old compared to the 30–32 ft. boats, for which preference has been shown in recent years. The total diesel requirements of these local boats are estimated to be 29,560 litres per day (Table 10).

Shortage in diesel oil is a problem frequently faced by the fishermen of Sakthikulangara and Neendakara. Besides the local boats, large number of boats coming from other areas operate from this centre during part of the year. In the lean season even some of the local boats migrate to other places for fishing. Hence calculation of the fuel requirements for fishing operations at Sakthikulangara/Neendakara must also take into account these factors.

The average number of boats operating daily during 1978–80 period was 595 (Table 11). Neendakara Bay is relatively quiet during the monsoon months of June to September and at this time prawns are available in

Table 10. *Mechanised boats with size, horse power and their average diesel requirements per day*

Size of boat (ft.)	No. of boats with range of horse power 24–30	30–40	40–50	50–60	60–80	80 & above	Total boats	Average diesel required per day (litres)	Average diesel required per boat/ day (litres)
24–26	32	4	1	—	—	—	37	930	25
28–30	—	29	26	2	—	—	57	2,000	35
30–32	—	18	74	83	59	8	242	26,630	110

Table 11. *Monthwise average number of mechanised boats operating per day during* 1978-80 *at Sakthikulangara*

Month	Average No. of units operating per day		
	1978	1979	1980
January	850	160	205
February	333	205	218
March	318	190	467
April	359	274	672
May	942	669	953
June	1,003	287	662
July	1,578	931	1,220
August	1,360	916	740
September	963	725	1,128
October	371	437	449
November	300	368	334
December	288	228	285

plenty. Hence a large number of boats migrate to this centre during this period and engage in trawling operations. On account of this there is a sharp rise in the demand for diesel oil in this season. However shortage of the same was observed during this period which resulted in many of the boats being kept idle or their operations being restricted. It is estimated that on the average 960 boats go for daily fishing during this period and the diesel requirement for these boats amounts to nearly 1 lakh litres per day. A regular supply of this quantity of diesel will go a long way in meeting the fuel demand of the mechanised boats.

Fish landings by mechanised boats

The annual fish landings by mechanised units at Sakthikulangara from 1970 to 1980 are given in Table 12.

During the period 1970–75 the total catch showed an increasing trend from 26,704 tonnes to 1,51,095 tonnes except for 1972 when there was a fall. During this period the effort expended also showed a steady increase. The catch and effort expended showed a sharp decline in 1976 and revived again in 1977–78 period. However a fall was observed both in catch and effort in 1979. But in 1980 the effort expended increased tremendously to 48,43,440 man hours realising a catch of 84,556 tonnes. In general, the prawn catches also showed an increasing trend during 1970–75 period, attaining a maximum catch of 56,750 tonnes in 1975. But in the subsequent 1976–80 period the landings of prawns fluctuated from 14,582 tonnes to 36,559 tonnes (Fig. 5).

It may be noted that the increase in effort has not resulted in proportionate increase in the total catch. The CPUE for total catch showed an overall decline from 182.67 kg/hour in 1970 to 17.46 kg/hr in 1980, maximum CPUE being 186.25 kg/hr in 1971. Similarly the CPUE for prawns also showed an overall decline to 7.55 kg/hr. in 1980 from the maximum of 82.6 kg/hr in 1973. Though there have been fluctuations in the landings of fish and prawns and also decline in their

Table 12. *Annual fish landings by mechanised boats at Sakthikulangara from* 1970–1980

Year	Total effort in man hours	Total catch (tonnes)	CPUE for total catch (kg/hr)	Prawn catch (tonnes)	CPUE for prawns (kg/hr)
1970	1,46,185	26,704	182.67	1,845	12.60
1971	2,76,476	51,493	186.25	11,004	39.80
1972	3,83,227	23,622	61.64	11,267	29.40
1973	5,50,370	66,064	120.04	45,477	82.60
1974	8,23,719	77,748	94.39	27,764	33.70
1975	13,31,728	1,51,095	113.46	56,750	42.60
1976	5,36,897	29,836	55.57	14,993	27.90
1977	13,36,732	45,828	34.28	24,121	18.00
1978	24,13,475	89,892	37.25	33,143	13.70
1979	7,23,730	56,016	77.40	14,582	20.10
1980	48,43,440	84,556	17.46	36,559	7.55

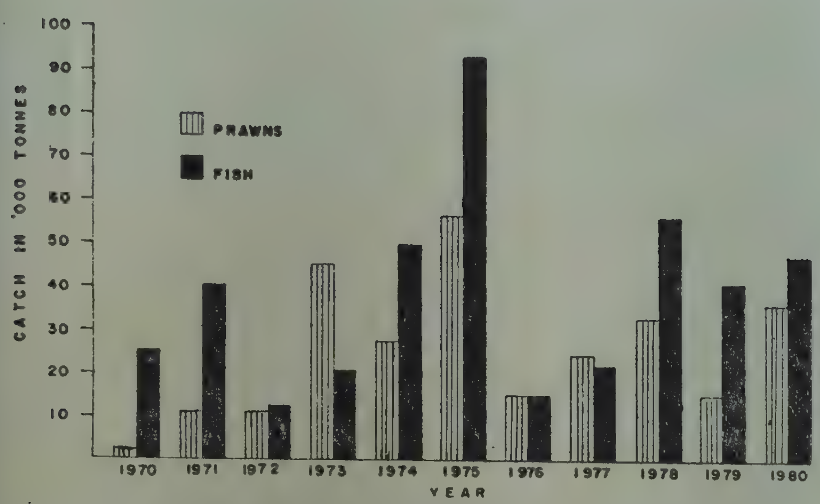


Fig. 5. Annual landings of fish and prawns by mechanised boats at Sakthikulangara (1970–1980).

catch rates in recent years, this has not adversely affected the economic conditions of fishermen because of the increase in the unit value realised for prawns as well as fish.

Out of a total of 84,556 tonnes of fish landed during 1980, as much as 61% (51,205 tonnes) are caught by the boats that have come from outside and only 39% (33,351 tonnes) are accounted by the mechanised boats belonging to Sakthikulangara/Neendakara (Table 13).

However seasonal variations were noticed in the share of the total catch between the local boats and outside boats. In the first 4 months (i.e. January to April) the local boats accounted for 60% of the output as against 40% by outside boats. During the subsequent May to September period, there was a reversal in the trend, the landings by the outside boats being 68% and by the local boats 32%. This reversal is due to the large number of boats migrating from other places to Sakthikulangara to fish for prawns which are caught in large quantities in this period. With the end of the "Karikadi" fishery in September the boats that migrated from outside leave Sakthikulangara to other areas. Hence during October–December period the share in the total catch for local boats rose to 85%.

The number of persons engaged in non-mechanised fishing is 285 and 347 in Sakthikulangara and Neendakara respectively, operating 214 indigenous crafts. Although the landings by the non-mechanised crafts of this area

Table 13. *Monthly output generated (catch in tonnes) during* 1980 *by the local mechanised boats and those that have come from outside*

Months	Mechanised boats from Sakthikulangara–Neendakara		Mechanised boat from outside		
	Average No. of local units operating per day	Monthly output	Average No. of outside units operating per day	Monthly output	Total output
January	205	654	—	—	654
February	218	699	—	—	699
March	320	1,564	147	718	2,282
April	320	2,764	352	3,040	5,804
May	320	2,657	633	5,255	7,912
June	320	1,800	432	1,923	3,723
July	320	7,875	900	22,150	30,025
August	320	4,982	420	6,539	11,521
September	320	4,167	808	10,520	14,687
October	320	2,355	129	949	3,304
November	320	2,526	14	111	2,637
December	285	1,308	—	—	1,308

alone are not available, the catches of this traditional sector for the whole coastal belt of Quilon District with 33 landing centres including Sakthikulangara–Neendakara have been 19,453 tonnes in 1978, 11,927 tonnes in 1979 and 20,463 tonnes in 1980. These catches mainly comprised sardines, anchovies, perches, carangids, catfishes, *Lactarius* and mullets.

Marketing

At Sakthikulangara, gill netters land their catches in the morning hours, while in the afternoon, catches from trawlers are landed. In addition, indigenous boats also land their catches in an adjacent area meant for them. The gill netters bring their catches to the jetty between 6 AM and 9 AM during which period marketing of the same is held. The trawlers land their catches from about 11 AM to 5 PM. The catches are disposed off by auctions at the landing centre itself. The quantity of fish auctioned in the afternoon is much more than that auctioned in the morning.

A study of the disposal of the catch to the different categories of buyers at the landing centre during the observation period (March–April 1980) was made and the details are furnished in Table 14.

Table 14. *Number of buyers (per day) from different categories and the fish purchased by them in percentages (March-April* 1980)

S. No.	Category	Number	Quantity purchased (per cent)
1.	Agents of Freezing plants	50	36
2.	Wholesale traders	130	23
3.	Commission agents	75	12
4.	Cycle vendors	475	11
5.	Head load vendors	770	13
6.	Others	700	5
	TOTAL	2,200	100

Among the various categories of buyers, headload vendors comprising mostly women form the maximum number (35%). They go to the nearby markets and interior areas for selling the fish. At times a few headload vendors join together and hire a cart for transportation of fish to the market for selling. They are followed by "others" (32%) comprising miscellaneous groups of buyers such as hoteliers, old fisherfolk and people coming from nearby areas to buy in small quantities for domestic consumption. The next important category is cycle vendors (22%) who buy basket loads of fish and carry them in their cycles to the interior places up to about 40 km. The number of wholesale traders constitute 6% in the total. They purchase either directly from the boat owners or from commission agents. Commission agents are also one among the buyers who sell on the spot itself or send the same for sale to various destinations by road or by train. Agents deputed by the prawn processing companies (2%) buy large quantities of prawns. It may be noted from the table that maximum quantity of the catches are purchased by agents of freezing plants and by wholesale traders. Their purchases further go up during the "Karikadi" season in June–August period.

A study was made during the period of survey regarding the quantities of fish (including prawns) sold in fresh condition for immediate consumption and for processing which includes not only freezing but also curing, salting etc. (Table 15).

Table 15. *Percentage distribution of fish for processing and fresh sale (April-May)* 1980

Species	Per cent distribution Processing	Fresh
Prawns	85	15
Cat fish	50	50
Tuna	15	85
Pomfret	—	100
Seer	10	90
Sharks	60	40
Rays	60	40
Nemipterus	20	80
Oil sardine	20	80
Mackerel	10	90
Others	15	85

It could be observed from the Table that as much as 85% of the prawns are taken for freezing for export. The remaining 15 per cent did not go for freezing because of their small size, not being suitable for export. As good landings of cat fish occurred during this period, only 50 per cent could be absorbed for fresh sale, the rest going for curing. Except for sharks and rays, the rest of the fishes mostly go in for fresh sales.

Table 16. *Price of fish at Sakthikulangara and Quilon*

Name of fish	Average price per kg. received by fishermen at Sakthikulangara (Rs.)	Average retail price per kg. at Quilon market (Rs.)	Margin percentage increase per kg.
Seer fish	10.00	14.00	+ 4.00 (40%)
Pomfret	10.00	15.00	+ 5.00 (50%)
Cat fish	3.50	5.50	+ 2.00 (57%)
Tuna	5.00	7.50	+ 2.50 (50%)
Rays	2.50	3.50	+ 1.00 (40%)
Oil sardine	1.00	2.00	+ 1.00 (100%)
Mackerel	2.75	4.50	+ 1.75 (64%)

The prices of selected species of fish at Sakthikulangara landing centre and the price it fetched at Quilon market were observed at regular intervals during March–May 1980 and average of the same are furnished in Table 16.

The difference in the prices for the various varieties of fish between the landing centre and the market ranged from 40 per cent to 100 per cent. The range in the increase in the price of rays, seer fish, pomfret, catfish and tuna was 40 per cent to 57 per cent. The maximum difference in prices was observed in the case of mackerel and oil sardine and this can be attributed to their scarcity in the market at this period.

Exports

Sakthikulangara–Neendakara is the most important centre for processing and freezing of prawns, ranking only next to Cochin. Almost entire quantity of prawns are frozen for export. The quantity of marine products exported, the value realised and the unit value per kg are shown in Fig. 6.

During 1970–'75 period, the quantity of marine products exported was in the range of 3,000 to 4,000 tonnes fetching between 4.6 to 7.8 million rupees. However a decline in the exports was noticed during 1976—79 period, the range being 1,000 to 2,000 tonnes. The price realised was 3.3 to 5.1 million rupees. But there was a recovery in the exports to the tune of 2,318 tonnes during 1979–80. During 1970–80 there was a steady rise in the unit value realised per kg from 13 rupees to 40 rupees. The spectacular rise in the value realised in 1979–80 is due to the increase in terms of quantity as well as unit value realised per kg.

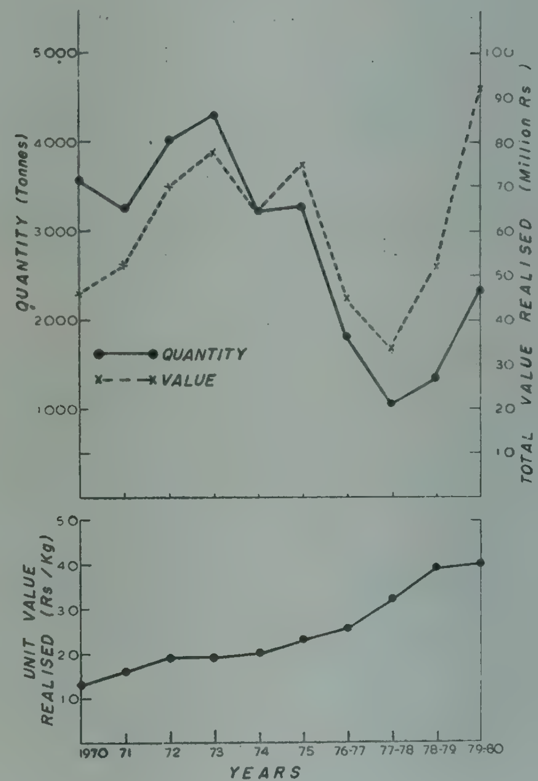


Fig. 6. Quantity, value and unit value of exports of marine products(1970–1980) from Sakthikulangara–Neendakara. (Source: MPEDA)

Conclusion

The impact of mechanised fishing in the last two decades on the living conditions of the people of Sakthikulangara–Neendakara area has been manifold. Housing is one of the important parameters in assessing the economic progress of the people and in this field significant improvement has been noticed as compared with that of fifties (Table 17).

Table 17. *Percentage of different types of houses in* 1954 *and* 1980

	Sakthikulangara		Neendakara	
Types of houses	1954	1980	1954	1980
Huts	47	33	65	64
Kutcha	44	16	29	16
Pucca	9	32	6	15
Mansion	—	19	—	5

The proportion of Kutcha houses decreased from 44 per cent in Sakthikulangara and 29 per cent in Neendakara in 1954 to 16 per cent in 1980 in both the places. As regards pucca houses and mansions their proportion increased from 9 per cent to 51 per cent in the former place and 6 to 20 per cent in the latter place. However the decline in the proportion of huts in Sakthikulangara is 14 per cent, the same being only one per cent in Neendakara. The marginal decline in the proportion of huts in Neendakara shows that the development benefits did not accrue to the dwellers of huts of this place to the extent observed in the case of Sakthikulangara.

Though information relating to the number of literates among the total population in this area in the fifties and sixties could not be obtained, it is obvious that great progress has been made during this period in this field as evidenced by the fact that at present as much as 79.5 per cent of the population of this area are literates. However information was available as to how many among literates were in different levels of education in 1954 and a comparison of the same with the existing situation shown in Table 18 gives an idea of the marked improvement that has since taken place.

Table 18. *Percentage with primary education, middle, higher secondary and above in* 1954 *and* 1980 *in Sakthikulangara-Neendakara area*

Educational status	1954	1980
Primary	67	46
Middle	18	22
Higher secondary and above	15	32

Reference to Table 4 would show that the percentage of illiterates is more in Sakthikulangara than in Neendakara even though the former place is economically in a better position than the latter. This can be due to the desire of the parents of lower income group of Sakthikulangara to send their boys for fishing and other related activities at an early age thereby getting a good income, in preference to sending them to schools. But for the people of Neendakara the opportunities for the boys to get employed in fishing vessels and fishery related activities are relatively less and hence the poor parents send their children to schools where they get free midday meals.

One of the major benefits derived on account of mechanisation is the increased employment opportunities in Sakthikulangara–Neendakara area. Fishing and fishery related activities provided employment for about 2,100 persons in 1953, 2,400 in 1963, 5,800 persons in 1968 (Agricultural Division, State Planning Board, Kerala–1969) and about 7,500 persons in 1980, the increase at present being more than 3½ times over that of 1953. The growth is more striking if we take the persons employed in the subsidiary industries alone. The increase in this field was from 300 workers in 1963 to 2,100 workers in 1968 and 3,000 workers in 1980. However it may be observed that out of the total of 7,500 persons employed, only 2,219 are drawn from Sakthikulangara–Neendakara, the rest hailing from other places. One interesting feature noticed is that a greater percentage of people are unemployed in Neendakara than in Sakthikulangara. This can be due to more job opportunities being available in Sakthikulangara than in Neendakara, as in the former place the process of mechanisation has gone farther than in the latter.

As a consequence of the introduction of mechanised fishing there was a reduction in the number of indigenous boats in this area from 493 in 1953 to 214 in 1980. At the same time mechanised boats possessed by the people of this area increased from 138 in 1963 (Agricultural Division, State Planning Board, Kerala, 1969) to 336 in 1980.

There has been significant increase in the infrastructure facilities also. The ice production capacity which was 25 tonnes in 1963, rose to 83 tonnes in 1968 and 350 tonnes in 1980. The freezing capacity per day which stood at 9 tonnes in 1963 increased to 37 tonnes in 1968 and to 75 tonnes in 1980. Similarly the cold storage capacity also showed an increase from 325 tonnes in 1963 to 785 tonnes in 1968 to the present capacity of 1,330 tonnes.

The process of mechanisation during the last two decades has a great impact in the total landings of fish and prawns in Sakthikulangara–Neendakara area. This has resulted in better exploitation of resources realising more catches of prawns, seer fish, pomfrets, tunnies etc. The catch which had been in the neighbourhood of 2,000 tonnes in 1953 rose to 13,000 tonnes in 1968 and in 1980 it is 85,000 tonnes. Although there has been an enormous increase in the catches as compared to that of the sixties, a declining trend in the catches is observed with increasing input of effort over the successive years in recent times as reported in *Marine Fisheries Information Service T & E Series No.* 18, 1980. Hence it has become necessary that conservation measures be taken to restrict the catches to the level of maximum sustainable yield in the coming years.

Another far reaching impact of mechanisation was seen in the exports of marine products from this area. In 1953 only dried prawns and fish were exported, valued at less than 100 thousand rupees. Export of frozen prawns and lobsters commenced only in the late fifties with the establishment of freezing plants and cold storages. In 1967 the quantity of marine products exported from here was 1,736 tonnes valued at 19.69 million rupees, in 1970, it was 3,597 tonnes valued at 46.43 million rupees and in 1979–80, 2,318 tonnes valued at 92.18 million rupees as per statistics given by MPEDA. Even though there was a sharp increase in the landings of prawns in Sakthikulangara from about 2,000 tonnes in 1970 to 36,559 tonnes in 1980, this is not reflected in the export figures from this place. This may be due to the constraints imposed in limited freezing capacity (75 tonnes) per day which is not enough especially during the peak season and also due to large quantities of prawns going for processing to outside places like Quilon, Alleppey and Cochin etc.

The greatest impact of mechanisation is seen in the level of income of the people of Sakthikulangara and Neendakara. The report of the State Planning Board, Kerala, 1969 reveals that the annual income per fishermen household in this area was Rs. 624 in 1954 and Rs. 1,251 in 1963 with per capita income of Rs. 118 and Rs. 192 respectively. In 1980 the annual income per fishermen household has risen sharply to Rs. 4,975, the per capita income being Rs. 887. Thus an eight fold increase has been noticed since 1954 in the annual as well as per capita income.

However it is seen that the benefits arising out of the introduction of mechanised fishing are seen more in Sakthikulangara than in Neendakara. The annual income per fishermen household in Sakthikulangara in 1980 works out to Rs. 6,420 with a per capita income of Rs. 1,184, whereas the same for Neendakara is Rs. 3,529 and Rs. 590 respectively. This is because the developmental activities are more centred in Sakthikulangara than in Neendakara. Almost all the mechanised boats land at Sakthikulangara which has jetty and other facilities and this in turn have brought more business transactions leading to higher prosperity of the people.

The average indebtedness of the fishermen families in this area was found to be Rs. 449 in 1954 and Rs. 286 in 1963 (Asari T.R.T. and M.D. Menon, 1963). At present the average outstanding debt per indebted household in Neendakara and Sakthikulangara works out to Rs. 6,671 and Rs. 29,786 respectively. This huge increase in the indebtedness can be attributed to the fact that a good number of them took substantial loans from banks and other agencies for the purchase of mechanised boats to be paid back on easy instalments. Hence this need not be considered as a negative impact, as the bulk of the loans has been utilized for investment on productive purposes.

Although there has been a rise in the income level of the people of this area, it is seen that as much as 53 per cent of the fishermen families still get an income of less than Rs. 3,600 per annum. The families in the middle and higher income groups are more benefited by the additional income generated due to the introduction of mechanisation in fishing as also indicated by the decrease in the percentage of kutcha houses, increase in pucca houses and mansions in the places. The financial position of the lower income groups could not permit them either to purchase mechanised boats or to invest huge amount of money on fishery related activities which are having high income generating potential. Hence further developmental programmes should be so formulated to take care of this sector. A good number of people of this category get only seasonal employment in fishery related activities such as peeling and curing. Development of small scale industries like coir making and net making which have a good scope in this area will enable these people to be gainfully employed during the off season.

Finally it may not be out of context here to mention about the major constraint in the development of this area, which is the lack of a fishing harbour. During the peak season of June to August as much as 1,000 to 2,000

boats land here and the whole process of transferring the catches from the boats to the shore, marketing, processing and transportation is at present carried out at the crowded jetty and the premises. The State Government should take up the matter of construction of the proposed fishing harbour at Sakthikulangara under top priority. A harbour with berthing facilities for the maximum number of fishing vessels, auction halls, peeling sheds, approach roads and such other infrastructures will go a long way not only in bringing about improved conditions of landing the catches at the most important mechanised boat landing centre of the country but also give an impetus to the growth of the fishing industry in this area.

We are thankful to Shri T. Jacob and other colleagues in Fishery Resources Assessment Division for their help in the preparation of this report. We also thank Shri S. B. Chandrangathan for assistance in collecting the data.

NEWS—INDIA AND OVERSEAS

Fishing harbour at Nizamapatnam

With the assistance of World Bank funds a major fishing harbour is scheduled to be commissioned in 1982 at Nizamapatnam on the east coast of India. Nizamapatnam located near the mouth of the River Krishna in the state of Andhra Pradesh is about 310 km north of Madras and 330 km south of Visakhapatnam. At present fishing is conducted along the coast including the fertile fishing grounds off the mouth of the river Krishna by indigenous craft protected by the bay at the river mouth throughout the year and small mechanised boats operating from distant bases during three months in an year. With the harbour facilities developed here the operations of these mechanised boats could be improved considerably round the year.

The site of the harbour selected by the United Nations Development Programme is about 400 m from the entrance to the sea and a new channel which would also locate the harbour basin will be cut through the sand and the present channel filled up. The landing quay has been designed to hold 45 boats of 9 m length and 9 boats of 10 m length. The entire project would cost Rs. 87 million.

Vast new fishing grounds located in the Arabian Sea

In a recently completed two-year Indian Ocean fishery programme involving several countries and supported by the United Nations Development Programme (UNDP) and the Food and Agricultural Organisation (FAO), the Norwegian research vessel *Dr. Fridtjof Nansen* undertook five exploratory cruises in the Arabian Sea from Pakistan to Somalia. The programme has uncovered a vast fishing ground in this area, which, according to scientists, has the potential of 100 million tonnes of fish, a quantity considered sufficient to increase the present world fish supply by 10 to 25% per year.

With the aid of sophisticated acoustic equipments the survey discovered important concentrations of both small pelagic fish such as sardines, horse mackerel and anchovies as well as demersal fish including ponyfish, threadfin bream, catfish and other varieties. Both these groups of fish are being exploited to some extent in the region. But according to the present survey the rich fishing grounds could bring millions of dollars more to the four countries concerned, namely, Pakistan, Somalia, Oman and the People's Democratic Republic of Yemen by systematic exploitation of the resources available.

World Fishing 29 (10):October 1980

Living pollution-monitoring system

As a part of an extensive research programme the Shell Oil Company in U.K. has found a novel use for mussels as a living pollution—monitoring system. In order to determine the long term effects of off shore oil

operations on the marine environments, mussels are made use of as "living samplers." In the experiment the mussels taken from the north-east coast of Scotland have been planted in the middle of Brent, the UK's biggest oilfield. The mussels were placed in cages carefully positioned by divers at upto a half-mile from oil installations at depths varying from 15 to 125 m.

The experiment is part of the overall research programme designed to find where wastes go, how they dilute and degrade and what their long term effects may be. Since the mussels are continuously filtering litres of sea water for straining out food and all other particles they act like blotting papers, collecting and accumulating minute amounts of chemicals too. Apparently, the mussels which have settled on the oil rigs cannot be made use of for the study, as these mussels would have already accumulated oil and other chemicals, making it difficult to detect changes.

Fishing News, November 28, 1980

Breakthrough in shrimp farming reported

At the first workshop on cryobiology of marine organisms sponsored by the Texas A & M University Sea Grant College Program, the Texas Agricultural Experiment Station and Texas Agricultural Extension Service, Dr. A. Laurence of Texas A & M University reported the results of cryopreservation of shrimp spawns which would be a major breakthrough in shrimp farming.

According to him shrimp spawns could be frozen at temperatures dipping to minus 385 degrees Fahrenheit and preserved for later use in rearing and farming. This method of cryopreservation would result in economic advantages to shrimp farmers as the cost of freezing and storing shrimp seed stock could be as little as 2 cents per 1,000 seeds compared to a selling price of 1$ to 2$ per 1,000. This would allow shrimp farmers to store seed stock, reduce costs, simplifying transportation and guarantee brood stock supplies. Another advantage would be the possibility of running facilities year-round, taking seed stock from frozen storage and placing into mariculture systems as and when needed.

Texas Trawler 7 (3): December 1980

Sri Lanka taking to atom fresh fish

As a result of the recently concluded Agreement on Peaceful Uses of Atomic Energy between Sri Lanka and France, Sri Lanka housewives will soon be able to keep wet fish on the shelves for a week without any fear that it might spoil.

By irradiating, wet fish can be kept without decay for more than a week and this is the cheapest and safest form of fish preservation. Unlike deep freezing, irradiation does not affect the taste and quality of the fish. This method of fish preservation was widely used in Japan.

FNI 19 (7): July 1980

Compiled and prepared by M. J. George, S. K. Dharmaraja & G. Subbaraju.
Published by Dr. M. J. George, Senior Scientist on behalf of the Director, Central Marine Fisheries Research Institute, Cochin-682 018 and printed at PAICO, Cochin-31

MARINE FISHERIES INFORMATION SERVICE

Technical and Extension Series

No. 30

AUGUST 1981

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE

COCHIN, INDIA

INDIAN COUNCIL OF AGRICULTURAL RESEARCH

THE MARINE FISHERIES INFORMATION SERVICE: Technical and Extension Series envisages the rapid dissemination of information on marine and brackish water fishery resources and allied data available with the Fishery Data Centre and the Research Divisions of the Institute, results of proven researches for transfer of technology to the fish farmers and industry and of other relevant information needed for Research and Development efforts in the marine fisheries sector.

Abbreviation – *Mar. Fish. Infor. Serv. T & E Ser., No.* 30: 1981

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Cover photo: Publicity posters

PREFACE

The Central Marine Fisheries Research Institute (CMFRI), Cochin is conducting quinquennial census on marine fishermen population and infrastructure facilities since 1948 as part of the Fishery Resources Assessment Division programme. This census serves the purpose of periodical updating of the frame on marine fish landing centres which is required for the estimation of marine fish catch in India. The information on infrastructure facilities available in the marine fishing villages forms a good base for planning and development of this economically backward sector. The National Commission on Agriculture has also recommended that such census should be undertaken by CMFRI, with the help of State Fisheries Departments periodically, preferably once in five years.

During 1980 CMFRI has undertaken this census, covering 7 maritime States viz. West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Kerala, Karnataka and Gujarat and two Union Territories namely Pondicherry, Karaikkal, Mahe and Yanam and Goa, Daman and Diu. This is the first time that the Institute has carried out the census operations on an intensive and massive scale within a short period of less than a month availing the services of about 1500 persons engaged locally besides 165 of this Institute staff. The task involved strenuous field work covering difficult terrain and visits to almost inaccessible marine fishing villages. Altogether 2,132 marine fishing villages with 1,442 landing centres have been visited covering a total of 3,33,038 households.

The Fishery Resources and Assessment Division of the Institute organised and carried out this census with the active co-operation of large number of scientists and technical personnel of all the Divisions of this Institute. The help rendered by the respective State Governments went a long way in the successful conduct of this census.

Based on the analysis of census data, the Institute proposes to bring out a few publications. In the present publication, district-wise details on the distribution of marine fishermen population, their educational status, number of fishermen engaged in actual fishing and number of crafts and gears owned by fishermen are given. It is hoped that the information furnished in this report would be useful to the State Governments, Central and other agencies involved in the development of marine fisheries sector. The list of scientific and technical personnel of the Institute who actively participated in the census programme is appended.

I wish to place on record my sincere appreciation to the hard work put in by my colleagues of this Institute who were associated in this venture and of the whole hearted co-operation extended by the officials of the State Fisheries Departments. S/Shri T. Jacob, G. Venkataraman, K. Alagaraja and S. K. Dharmaraja had also seen to the effective co-ordination of the programme.

E. G. SILAS
Director

ALL INDIA CENSUS OF MARINE FISHERMEN, CRAFT AND GEAR: 1980*

Introduction

For planning developmental programmes in marine fisheries sector, the information such as the number of fishing villages, landing centres, fishermen population, active fishermen, fishing crafts and gears in the maritime states of India is a prerequisite. Such information also provides the frame needed for conducting sample survey for estimation of marine fish production and fishing effort in India. Further, periodic frame surveys are necessary to understand the status of the traditional small scale fisheries sector in the changing pattern of fishing industry. Keeping these in view, the Central Marine Fisheries Research Institute has been conducting frame surveys at periodic intervals ever since 1948–49. The National Commission on Agriculture has emphasised in its recommendation that CMFRI should conduct quinquennial census in order to update the inventory of fishing resources available in the coastal villages with the help of State Governments. This gave a fillip to the Institute to organise the census on a massive and intensive scale. The field work was carried out during May–July 1980 in all the maritime states in the mainland except in Maharashtra. The census work in Maharashtra was not taken up as the same was carried out by the Maharashtra Government in the previous year.

The planning for the conduct of the census at all India level was done much in advance. A team of scientists of the Fishery Resources Assessment Division visited various states and sought the co-operation of the state officials. The different schedules to be used for the collection of census data were prepared and finalised in consultation with State Governments. The major items on which information was collected in the house-hold schedule were family size, educational status, number of active fishermen, number of mechanised and non-mechanised fishing crafts and number of fishing gears. Since the schedules were to be filled in with the help of local persons, they were printed bilingual —English and the regional language. Suitable publicity materials in the form of attractive folders and wall posters in respective local languages were also prepared.

The programme of work was executed by the Fishery Resources Assessment Division with the participation of a large number of scientific and technical personnel of the various divisions of the Institute in the field operations. All the State Departments extended their full co-operation in the conduct of the census and particularly the Fisheries Departments of Orissa, Pondicherry and Gujarat lent the services of some of their staff for the field work. Orientation training for the staff was conducted at Contai, Cuttack, Waltair, Madras, Mandapam Camp, Cochin, Karwar, Veraval and Bhuj. Wide publicity was given through the press, Akhasvani and Doordarshan sufficiently in advance highlighting the census work.

The enumeration work was conducted during May–July 1980 in the maritime states of West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Kerala, Karnataka, Gujarat and the two Union Territories of Pondicherry and Goa. Over 2,000 marine fishing villages were visited and census data collected as per the village and household schedules through house-to-house canvassing.

In the collection of census data the terms used are defined as follows:

1. Marine fisherman is one who is engaged in marine fishing/associated activities.

2. Marine fishing village is an assemblage of houses where marine fishermen live.

3. Fish landing centre is a place where fishermen land their catch.

4. Fishermen family is one in which atleast one member is engaged in marine fishing/related activities.

5. Fishermen engaged in actual fishing:

   i) Full time category includes those fishermen who spend atleast 90% of their time in fishing.

   ii) Part time includes those who spend at least 30% but less than 90% of their time in fishing.

   iii) Occasional includes those who spend less than 30% of their time in fishing.

*Prepared by the Fishery Resources Assessment Division.

Excludes Maharashtra State for which figures will be published shortly.

6. Educational status:

   i) Primary standard refers to those who have completed V std.

   ii) Secondary standard refers to those who have completed X std.

   iii) Above secondary refers to those who continued their studies after X standard.

7. Children are those who have not completed their 12th year of age irrespective of their sex. All others come under adult.

Census figures for the whole country, states and districts excluding Maharashtra, Andaman and Lakshadeep are discussed in the ensuing account.

Summary census details of all maritime states of India (Figs. 1—8)

The statewise details of census figures in India are given in Tables 1 & 2. The number of marine fishing villages in India (excluding Maharashtra, Andamans and Lakshadweep) is 2,132, the number of landing centres being 1,438. There are 3.33 lakh fishermen households with the total marine fishermen population of 18.93 lakhs. Adult males and females comprise about 31% each and children 38%. The average family size works out to 5.7. Of the total population, 15% are educated upto primary standard, 3% secondary and 1% continued studies above secondary standard. The fishermen engaged in actual fishing form 23% of the total fishermen population. Among these engaged in actual fishing 82% come under full time, 11% part time and 7% occasional categories.

The number of mechanised boats in the country excluding Maharashtra, Andamans and Lakshadweep is observed to be about 14,000 (Table 21). About 9,300 mechanised boats are owned by the fishermen families, majority of them on a share basis. Of these about 6,300 are engaged in trawling (trawlers), 2,400 gillnetting (gill netters), 240 dol net fishing (dol netters) and 220 purse seining (Purse-seiners).

The ownership of mechanised boats is not confined to fishermen alone. There are mechanised boats owned by industrialists who do not reside in the marine fishing villages. Since this census covers only marine fishing villages, it was not possible to collect details of number of mechanised boats owned by this sector in each state during the limited time of the census. The frequent interstate movement of these boats in the waters of the different states also rendered it more difficult to collect this data. Hence in the sections dealing with the statewise analysis, mechanised boats owned by fishermen alone are considered. However, the details of the total number are given in table 21.

As regards non-mechanised fishing crafts, there are 1.35 lakh units of which about 73,400 are catamarans, 37,900 plank-built boats and 21,700 dug-out canoes.

There are about 14,000 trawlnets and 240 purse-seines. Among other gears, drift/gill nets are of the order of about 2.16 lakhs, hooks & lines being the next major gear with 57,000 numbers. The other gears are fixed bag nets (49,000), boat seines (30,000), shore seines (19,000), scoop nets (6,000) and Rampans (190).

District-wise details of different states

West Bengal

Census of marine fishermen population was conducted in the six districts of West Bengal viz. Murshidabad, Nadia, Hooghly, Howrah, 24 Parganas and Midnapore (Table 3 & 4). Though the former four districts are situated in the interior, there are some fishermen settled in these districts engaged in seasonal marine fishing.

Fishing Villages and landing centres

There are 303 fishing villages wherein marine fishermen reside. The maximum number is in Midnapore district (148) followed by Howrah (79) and 24 Parganas (58). The number of fishing villages in the remaining districts is very low ranging from 2 to 9. The total number of landing centres is 47, all the landing centres being situated in the districts of 24 Parganas and Midnapore.

Population

There are about 14,000 fishermen households in the state, the maximum number being in Midnapore district (35%), the next highest in 24 Parganas (31%) followed by Howrah (28%). Four per cent of the fishermen families are found in Murshidabad and one per cent each in Hooghly and Nadia districts. On an average the number of families per village is 47, the

Table 1. *Statewise figures of marine fishing villages and fishermen population in India*—1980

Sl. No.	Items	STATES									Total
		West Bengal	Orissa	Andhra Pradesh	Tamil Nadu	Pondichery, Karaikal, Mahe and Yenam	Kerala	Karnataka	Goa Daman Diu	Gujarat	
1.	No. of fishing villages	303	236	453	422	27	304	147	61	179	2,132
2.	No. of landing centres	47	56	379	375	27	222	105	54	173	1,438
3.	No. of fishermen households	14,169	20,329	72,862	75,721	4,625	99,894	15,638	6,725	23,075	3,33,038
4.	Fishermen population										
a)	Adults:										
	Male	27,547	37,536	97,364	1,26,967	7,362	2,10,609	32,715	12,459	42,835	5,95,394
	Female	23,624	33,837	96,459	1,26,691	7,544	2,09,853	34,888	12,398	42,249	5,87,543
b)	Children	32,390	45,771	1,32,481	1,42,245	10,406	2,19,410	45,290	15,055	66,931	7,09,979
	Total	83,561	1,17,144	3,26,304	3,95,903	25,312	6,39,872	1,12,893	39,912	1,52,015	18,92,916
5.	Educational status										
a)	Primary	15,606	7,618	20,386	60,075	4,922	1,19,823	21,596	7,060	23,901	2,80,987
b)	Secondary	2,752	2,045	3,562	11,897	1,370	23,514	5,174	2,617	4,067	56,998
c)	Above Secondary	452	359	429	3,860	270	5,317	1,553	338	911	13,489
	Total	18,810	10,022	24,377	75,832	6,562	1,48,654	28,323	10,015	28,879	3,51,474
6.	No. of fishermen engaged in actual fishing										
a)	Full time	9,026	20,617	73,506	87,442	5.021	1,11,970	17,664	6,841	25,616	3,57,703
b)	Part time	9,497	6,262	4,910	4,020	187	11,017	5,558	1,362	6,841	49,654
c)	Occassional	1,233	3,845	5,487	5,038	304	8,114	1,783	668	4,070	30,542
	TOTAL	19,756	30,724	83,903	96,500	5,512	1,31,101	25,005	8,871	36,527	4,37,899

Table 2. *Statewise figures of marine fishing crafts and gears in India—1980*

Sl. No.	Items	STATES									
		West Bengal	Orissa	Andhra Pradesh	Tamil Nadu	Pondicherry Karaikal, Mahe and Yenam	Kerala	Karnataka	Goa, Daman, Diu	Gujarat	Total
1.	*No. of fiishing crafts*										
a)	*Mechanised*										
	Trawlers	—	—	447	2,295	176	745	808	407	1,410	6,288
	Gill netters	247	106	9	324	—	215	23	213	1,225	2,362
	Dol netters	—	—	—	—	—	—	—	—	241	241
	Purse-seiners	—	—	—	—	—	9	173	39	—	221
	Others	63	—	—	8	—	14	74	—	18	177
	Total	310	106	456	2,627	176	983	1,078	659	2,894	9,289
b)	*Non-mechanised*										
	Plank built boats	3,972	3,262	11,359	8,957	83	4,376	1,747	1,108	3,040	37,904
	Dug out canoes	89	186	1,781	2,210	72	10,415	4,454	1,397	1,080	21,684
	Catamarans	—	6,276	22,198	31,851	1,595	11,480	23	8	—	73,431
	Others	—	4	675	325	—	—	718	—	—	1,722
	Total	4,061	9,728	36,013	43,343	1,750	26,271	6,942	2,513	4,120	1,34,741
2.	*No. of fishing gears*										
	Trawl nets	—	—	823	6,219	437	1,454	1,788	772	2,672	14,165
	Purse-seines	—	—	—	—	—	9	188	41	—	238
	Drift/gill nets	2,467	10,427	42,385	1,18,300	1,851	23,307	6,571	3,346	7,383	2,16,037
	Boat seines	—	2,676	9,738	7,220	375	9,779	23	165	—	29,976
	Fixed bag nets	6,200	2,778	14,617	1,842	152	—	941	430	21,857	48,817
	Hooks & lines	869	15,265	10,752	22,111	720	2,949	1,507	127	2,376	56,676
	Rampans	—	—	—	—	—	—	86	101	—	187
	Shore seines	436	2,893	3,042	4,549	84	2,926	3,924	987	—	18,841
	Traps	61	515	130	8,919	9	2,239	—	—	86,952	98,825
	Scoop nets	345	37	2,925	1,040	362	1,371	—	—	—	6,080
	Others	2,433	5,201	37,199	6,339	120	2,761	10,925	2,813	28,013	95,804

Figures in tables 2, 4, 6, 8, 10, 12, 14, 16, 18 and 20 refer to those owned/shared by fishermen.

Table 3. *Districtwise figures of marine fishing villages and fishermen population—West Bengal* 1980

Sl. No.	Item	DISTRICTS Murshi-dabad	Nadia	Hooghly	Howrah	24 Parga-nas	Midna-pore	Total
1.	*Number of villages*	9	7	2	79	58	148	303
2.	*No. of landing centres*	—	—	—	—	28	19	47
3.	*No. of fishermen households*	564	138	136	3,962	4,341	5,028	14,169
4.	*Fishermen population*							
a)	Male	966	273	200	6,130	8,536	11,442	27,547
b)	Female	989	212	179	5,385	7,344	9,515	23,624
c)	Children	686	279	269	8,937	9,249	12,970	32,390
	TOTAL	2,641	764	648	20,452	25,129	33,927	83,561
5.	*Educational status*							
a)	Primary	224	22	121	3,056	5,071	7,112	15,606
b)	Secondary	74	11	1	395	920	1,351	2,752
c)	Above secondary	11	3	1	57	264	116	452
	TOTAL	309	36	123	3,508	6,255	8,579	18,810
6.	*No. of fishermen engaged in actual fishing*							
a)	Full time	—	—	—	1,289	1,703	6,034	9,026
b)	Part time	589	190	171	3,143	3,290	2,114	9,497
c)	Occasional	11	—	1	493	463	265	1,233
	TOTAL	600	190	172	4,925	5,456	8,413	19,756

Table 4. *Districtwise figures of marine fishing crafts and gears—West Bengal* 1980

Sl. No.	Item	DISTRICTS Murshi-dabad	Nadia	Hooghly	Howrah	24 Parga-nas	Midna-pore	Total
1.	*No. of fishing Crafts*							
a)	*Mechanised*							
	Gill netters	4	—	2	—	184	57	247
	Others	—	—	—	1	47	15	63
	TOTAL	4	—	2	1	231	72	310
b)	*Non-mechanised*							
	Plankbuilt boats	25	7	10	1,160	1,640	1,130	3,972
	Dug out canoes	—	—	—	1	86	2	89
	TOTAL	25	7	10	1,161	1,726	1,132	4,061
2.	*No. of fishing gears*							
	Drift/gill nets	20	15	10	1,075	910	437	2,467
	Fixed bag nets	—	—	18	1,134	2,296	2,752	6,200
	Hooks & lines	—	—	—	244	565	60	869
	Shore seines	—	—	—	25	314	97	436
	Traps	—	—	—	1	60	—	61
	Scoop nets	—	—	—	—	263	82	345
	Others	—	18	—	268	283	1,864	2,433

number of persons being 276 per village. The average family size in this state works out to 5.9.

The total fishermen population in West Bengal is about 84,000 of which adult males constitute 33%, adult females 28% and children 39%. Break-up figures for different districts show that Midnapore district alone accounts for 41% of the total marine fishermen population while 24 Parganas and Howrah districts account for 30% and 24% respectively. The rest of the population (5%) is distributed in the remaining three districts.

Education

Nineteen per cent of the fishermen population have completed primary standard, 3% secondary standard and 1% continued studies above secondary standard.

Fishermen engaged in actual fishing

The number of fishermen engaged in actual fishing forms 24% of the total fishermen population. Among these the number of fishermen engaged in full time and part time fishing constitutes about 47% each and those engaged in occasional fishing 6%. In Midnapore district as much as 72% of the fishermen engaged in actual fishing belong to the full time category and only 25% come under the part time category. In the districts of 24 Parganas & Howrah the reverse is the case i.e., fishermen engaged in part time fishing are more in number than these engaged in full time fishing (60% and 64% respectively). Almost all the fishermen of Hooghly, Murshidabad and Nadia districts belong to part time category. The higher percentage of fishermen engaged in full time fishing in Midnapore district can be attributed to the greater opportunities for fishing in the district which has got a long coast line.

Fishing crafts

The total number of mechanised crafts owned by fishermen is 310. Out of this, gillnetters constitute 80%. The maximum number of mechanised boats is in the district of 24 Parganas (231), the next highest being in Midnapore district (72). Out of the 231 mechanised boats in 24 Parganas as many as 184 are gillnetters and the rest carrier boats. In Midnapore district also gillnetters form the maximum number (57), there being only 15 carrier boats. The number of mechanised boats in the possession of fishermen in the other districts is negligible. The reason for the large number of mechanised boats observed in 24 Parganas may be due to the availability of better infrastructure facilities at places like Diamond Harbour, Namkhana and Kakdwip.

Altogether about 4,100 non-mechanised boats are recorded in this state. 24 Parganas leads all other districts in the number of non-mechanised boats (43%) followed by Howrah district (29%). Midnapore district occupies the third place (28%). The number of boats possessed by the fishermen of Murshidabad, Hooghly and Nadia districts is very low. Among the two categories of non-mechanised boats viz. plank-built boat and dug out canoe the former dominates, constituting about 98%. However, relatively higher numbers of dug out canoes are noticed in the district of 24 Parganas as compared to other districts.

Fishing gears

Out of the gears observed, fixed bag net constitutes the maximum (6,200), the next highest being drift/gill net (2,500). The largest number of fixed bag nets is found in Midnapore (44%) followed by 24 Parganas (37%) and Howrah (18%). Maximum number of drift/gill net is observed in Howrah district (44%), the next highest being in 24 Parganas (37%) followed by Midnapore (18%)

Orissa

In Orissa, the census was carried out in the maritime districts of Balasore, Cuttack, Puri and Ganjam (Tables 5 & 6).

Fishing villages and landing centres

The number of marine fishing villages in Orissa State is 236, the maximum being in Balasore district (169), the next highest being in Ganjam and Puri (28 and 27 respectively). The lowest is in Cuttack (12). The number of landing centres in the state is 56, the largest number being in Balasore and Ganjam districts (20 each) followed by Puri and Cuttack.

Population

The total number of marine fishermen households in Orissa state is 20,300. Districtwise analysis of the fishermen families shows that the maximum is in Balasore district (61%), the next highest being in Ganjam (20%) followed by Puri (17%). Minimum number of fishermen families is observed in Cuttack district (2%). The average family size in the state works out to 5.8.

The total fishermen population in the state is 1.17 lakhs. Out of this, adult males constitute 32%, adult females 29% and children 39%. On an average, the number of persons per village comes to 496.

Districtwise analysis of the fishermen population shows that the maximum number is in Balasore district (64%), followed by Puri (18%), Ganjam (16%) and Cuttack (2%).

Table 5. *Districtwise figures of marine fishing villages and fishermen population—Orissa* 1980

Sl. No.		Item	DISTRICTS				Total
			Balasore	Cuttack	Puri	Ganjam	
1.		*No. of villages*	169	12	27	28	236
2.		*No. of landing centres*	20	5	11	20	56
3.		*No. of fishermen households*	12,316	393	3,472	4,148	20,329
4.		*Fishermen population*					
	a)	Male	24,145	886	6,733	5,772	37,536
	b)	Female	20,963	728	6,119	6,027	33,837
	c)	Children	29,410	1,047	7,888	7,426	45,771
		TOTAL	74,518	2,661	20,740	19,225	1,17,144
5.		*Educational status*					
	a)	Primary	6,119	25	1,180	294	7,618
	b)	Secondary	1,362	2	545	136	2,045
	c)	Above Secondary	215	—	118	26	359
		TOTAL	7,696	27	1,843	456	10,022
6.		*No. of fishermen engaged in actual fishing*					
	a)	Full time	11,539	442	4,938	3,698	20,617
	b)	Part time	4,204	349	643	1,066	6,262
	c)	Occasional	2,766	4	417	658	3,845
		TOTAL	18,509	795	5,998	5,422	30,724

Table 6. *Districtwise figures of marine fishing crafts and gears—Orissa* 1980

Sl. No.		Item	DISTRICTS				Total
			Balasore	Cuttack	Puri	Ganjam	
1.		*No. of fishing crafts*					
	a)	*Mechanised*					
		Gill netters	106	—	—	—	106
		TOTAL	106	—	—	—	106
	b)	*Non-mechanised*					
		Plank built boats	2,324	218	475	245	3,262
		Dug out canoes	103	—	76	7	186
		Catamarans	1	228	2,831	3,216	6,276
		Others	4	—	—	—	4
		TOTAL	2,432	446	3,382	3,468	9,728
2.		*No. of fishing gears*					
		Drift/gill nets	1,702	425	2,782	5,518	10,427
		Boat seines	141	19	1,467	1,049	2,676
		Fixed bag nets	2,507	198	1	72	2,778
		Hooks and lines	212	242	10,688	4,123	15,265
		Shore seines	2,475	—	58	360	2,893
		Traps	492	23	—	—	515
		Scoop nets	14	—	—	23	37
		Others	4,575	4	13	609	5,201

Education

Among the fishermen population, those who have completed primary standard forms 7%, secondary 2% and beyond secondary standard less than 1%.

Fishermen engaged in actual fishing

The number of fishermen engaged in actual fishing in this state is found to be about 30,700 forming 26% of the total fishermen population. Of this, the number of fishermen who are engaged in full time fishing constitutes 67%, part time 20% and occasional 13%. Among actual fishermen in Puri district as much as 82% belong to full time category, 11% to part time and 7% to the occasional. In Ganjam district 68% belong to the full time category and 20% and 12% to the remaining two categories respectively. In Balasore

district, the percentage of fishermen engaged in full time fishing is 62, the part time and occasional being 23 and 15 respectively. The percentage of fishermen belonging to full time category in Cuttack district is 55, part time being 44 and occasional 1.

Fishing crafts

The total number of mechanised boats owned by fishermen is 106, all these being gill netters from Balasore district. The total number of non-mechanised crafts is about 10,000. Ganjam and Puri districts lead the other districts with 36% and 35% respectively. In Balasore district, the number of non-mechanised crafts is less (25%), the lowest being in Cuttack district (4%). Among the different types of non-mechanised crafts in the state, catamarans constitute the largest number (64%) followed by plank-built boats (34%) and dug-out canoes only 2%. In Balasore district, plank-built boats constitute as much as 96%, whereas in Ganjam and Puri districts catamarans constitute the largest components of non-mechanised crafts viz. 93% and 84% respectively.

Fishing gears

Altogether seven types of gears are found in this state. Of these, hooks and lines constitute the maximum number (15,300) followed by drift/gill nets (10,400), shore seines (2,900), fixed bag nets (2,800) and boat seines (2,700). In Balasore district *Junjal,* a small purse seine constitutes the largest number in the category "others." Among the different types of gears, maximum number of drift/gill nets is observed in Ganjam district whereas maximum numbers of hooks and lines and boat seines are observed in Puri district. Fixed bag nets and shore seines form the largest number in Balasore district.

Andhra Pradesh

The Census on marine fishermen population was conducted in Andhra Pradesh in the nine coastal districts, namely, Srikakulam, Vijayanagaram, Vishakapatnam, East Godavari, West Godavari, Krishna, Guntur, Prakasam and Nellore (Tables 7 & 8).

Fishing villages and landing centres

There are 453 marine fishing villages in the entire coast of Andhra Pradesh with 379 fish landing centres. Regarding the number of marine fishing villages, Srikakulam leads having 24% followed by East Godavari (19%), Vishakapatnam (14%), Nellore (14%), Prakasam (13%), Krishna (6%), Guntur 5%, Vijayanagaram and West Godavari (3% each). The maximum number of landing centres is noticed in Srikakulam (86), followed by East Godavari (75), Nellore (56), Prakasam (52) and Vishakapatnam (50). The rest of the districts have only less than 30 landing centres each.

Population

There are about 73,000 fishermen families in this state. East Godavari district has the maximum (28%) followed by Srikakulam (22%), Vishkapatnam (16%), Prakasam (10%), Nellore (7%), Krishna (6%), Guntur (5%), West Godavari and Vijayanagaram (3% each). On an average, there are about 160 families per village. However, in East Godavari and Guntur average number of fishermen families per village exceeds 200, each having about 238 and 233 families respectively, lowest (83) being in Nellore district. The average family size is 4.5.

The total fishermen population is 3.26 lakhs. Among them, adult males and females form 30% each and children 40%. In the total population, East Godavari accounts for 26% followed by Srikakulam (23%), Vishakapatnam (18%), Prakasam (9%), Nellore (7%), Krishna (6%), Guntur (5%), Vijayanagaram and West Godavari (3% each). The average number of persons per village is 720.

Education

In the state, 6% of the fishermen population have completed primary standard, 1% secondary and less than 1% beyond secondary standard.

Fishermen engaged in actual fishing

There are about 84,000 fishermen engaged in actual fishing in all the nine coastal districts of Andhra Pradesh forming 26% of the total marine fishermen population. Of these, 88% fall under full time category followed by part time and occasional, 6% each. The percentage of fishermen engaged in full time fishing varies from 71 to 99 in the various districts of the State.

Fishing crafts

There are 447 trawlers and 9 gill netters owned by the fishermen of the state. The maximum number of

Table 7. *Districtwise figures of marine fishing villages and fishermen population—Andhra Pradesh* 1980

Sl. No.	Item	DISTRICTS									
		Srika-kulam	Vijaya-nagaram	Visakha-patnam	East Godavari	West Godavari	Krishna	Guntur	Prakasam	Nellore	Total
1.	No. of fishing villages	105	16	62	84	14	28	22	60	62	453
2.	No. of landing centres	86	15	50	75	10	26	9	52	56	379
3.	No. of fishermen households	16,026	2,195	11,472	20,045	2,328	4,658	3,960	6,939	5,239	72,862
4.	*Fishermen population*										
a)	Male	21,362	3,694	17,661	25,812	2,822	5,921	4,892	8,777	6,423	97,364
b)	Female	23,291	2,953	17,515	24,957	2,919	5,588	4,624	8,325	6,287	96,459
c)	Children	31,577	4,456	24,969	34,442	3,399	6,945	6,337	11,373	8,983	132,481
	Total	76,230	11,103	60,145	85,211	9,140	18,454	15,853	28,475	21,693	326,304
5.	*Educational status*										
a)	Primary	5,974	97	2,004	5,432	1,253	1,285	1,167	1,721	1,453	20,386
b)	Secondary	1,779	4	239	683	165	220	176	226	70	3,562
c)	Above secondary	201	—	20	75	34	25	21	50	3	429
	Total	7,954	101	2,263	6,190	1,452	1,530	1,364	1,997	1,526	24,377
6.	No. of fishermen engaged in actual fishing										
a)	Full time	12,279	3,164	14,716	20,368	1,798	4,125	3,570	7,273	6,213	73,506
b)	Part time	427	294	500	1,643	316	569	994	146	21	4,910
c)	Occasional	1,400	143	834	997	416	796	473	384	44	5,487
	TOTAL	14,106	3,601	16,050	23,008	2,530	5,490	5,037	7,803	6,278	83,903

Enumeration work in progress

Table 8. *Districtwise figures of marine fishing crafts and gears — Andhra Pradesh* 1980

Sl. No.	Item	Srika-kulam	Vijaya-nagaram	Visakha-patnam	East Godavari	West Godavari	Krishna	Guntur	Prakasam	Nellore	Total
		DISTRICTS									
1.	*No. of fishing crafts*										
a)	*Mechanised*										
	Trawlers	—	—	1	113	—	60	273	—	—	447
	Gill netters	—	—	—	1	—	—	8	—	—	9
	Total	—	—	1	114	—	60	281	—	—	456
b)	*Non-mechanised*										
	Plank built boats	898	634	2,180	5,387	144	1,226	828	14	48	11,359
	Dug out canoes	285	6	123	599	99	5	159	291	214	1,781
	Catamarans	7,555	370	5,163	2,340	—	1	323	3,694	2,752	22,198
	Others	2	1	108	218	17	2	11	192	124	675
	Total	8,740	1,011	7,574	8,544	260	1,234	1,321	4,191	3,138	36,013
2.	*No. of fishing gears*										
	Trawl net	—	128	—	367	1	130	197	—	—	823
	Drift/gill net	13,060	1,570	10,818	5,753	164	1,344	1,510	3,448	4,718	42,385
	Boat seine	2,821	592	2,648	1,953	58	—	46	949	671	9,738
	Fixed bag net	830	—	288	4,412	98	4,181	2,862	413	1,533	14,617
	Hooks & lines	4,769	974	2,871	341	—	302	50	1,164	281	10,752
	Shore seine	926	245	907	284	21	24	201	281	153	3,042
	Traps	—	—	125	—	—	5	—	—	—	130
	Scoop net	55	43	276	1,380	2	921	3	19	226	2,925
	Others	3,828	537	2,450	9,128	5,490	5,485	3,233	4,628	2,420	37,199

Discussion with village leaders

mechanised crafts is observed in Guntur, (62%), the next highest being in East Godavari (25%) followed by Krishna (13%), trawlers constituting the major fishing craft.

There are about 36,000 non-mechanised boats in the different districts of the State. Catamarans (62%) dominated the crafts followed by plank-built boats (32%) and dug-out canoes (5%). Among the districts, Srikakulam and East Godavari have the largest number of non-mechanised crafts (24% each) followed by Vishakapatnam (21%), Prakasam (12%), Nellore (9%), Guntur (4%), Krishna (3%), Vijayanagaram (3%) and West Godavari 1%.

In the districts of Srikakulam and Vishakapatnam, catamarans form the major craft (86% and 68% respectively) followed by plank-built boats (10% and 29% respectively). In the districts of Vijayanagaram, East Godavari, West Godavari, Krishna and Guntur, plank built boats form the dominant craft. Dug-out canoe is found to be the major craft in the districts of Prakasam and Nellore.

Fishing gears

There are about 800 trawl nets in the state, the maximum number being in East Godavari district (45%) followed by Guntur (24%), Krishna and Vijayanagaram (16% each). Of the remaining gears, drift/gill nets are maximum followed by fixed bag nets, hooks & lines, boat seines, shore seines and scoop nets.

Drift/gill nets form the major gear in all the districts of Andhra Pradesh except in Krishna and Guntur where the major gear is fixed bag net. Hooks & lines form the second major gear in the districts of Srikakulam, Vijayanagaram and Vishakapatnam. Boat seines form the third important gear in the districts of Srikakulam, Vijayanagaram, Vishakapatnam, East Godavari, West Godavari and Nellore.

Compared to the previous census conducted in the state during 1975–76, the fishermen population has increased by 37%. Similarly number of fishermen engaged in actual fishing also increased by 30%. There is an overall increase of 40% in the number of fishing crafts.

Tamil Nadu

The census was conducted in the 8 maritime districts of Chengalpattu, Madras, South Arcot, Thanjavoor Pudukottai, Ramanathapuram, Thirunelveli and Kanyakumari (Tables 9 and 10).

Fishing villages and landing centres

The total number of marine fishing villages in Tamil Nadu is 422 and landing centres 375. The maximum number of fishing villages and landing centres are seen in Thanjavoor district, being 87 and 84 respectively. Ramanathapuram district comes next in the order with 80 fishing villages and 64 landing centres followed by Chengalpattu with 65 each. In all other districts, the number of villages and landing centres are less than 60 each.

Population

There are about 76,000 fishermen families in Tamil Nadu, the maximum number being in Kanyakumari district (25%) followed by Thanjavoor (20%), Ramanathapuram (17%) and Thirunelveli (10%). In the remaining four districts the percentage was less than 10 in each. The average number of fishermen families in a village in this state works out to 179, varying from 77 in Pudukottai to 387 in Kanyakumari. The average family size is 5.2 in the state. Adult males and females form 32% each, the rest being children.

The total fishermen population in Tamil Nadu is about 3.96 lakhs, Kanyakumari recording the maximum number of fishermen forming 25% of the state total. The next highest percentage was seen in Ramanathapuram and Thanjavoor (18 each) followed by Thirunelveli district (11). In the remaining districts the percentages are less than 10 each.

Education

Out of the total fishermen population, 15% have completed primary standard, 3% secondary standard and 1% beyond secondary standard.

Fishermen engaged in actual fishing

The total number of fishermen who are engaged in actual fishing in the state is 96,500 forming about 24% of the total fishermen population. Of these, the number of fishermen who are engaged in full time fishing forms 91%, part time and occasional being 4% and 5% respectively. The districtwise analysis shows that the percentages of fishermen engaged in full time fishing range from 84 to 95, the maximum and minimum being

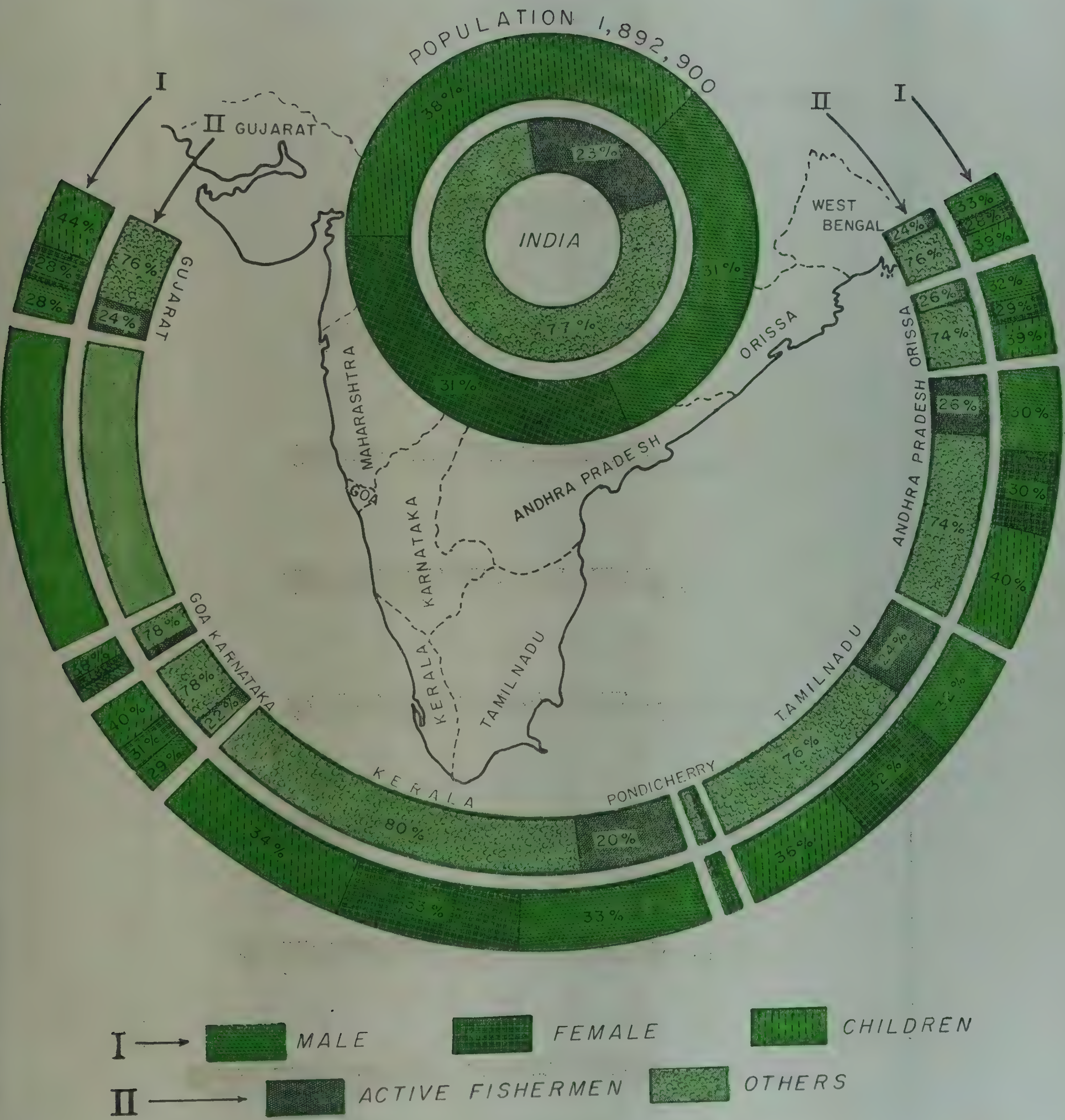

Fig. 1. Statewise distribution of marine fishermen population in India.

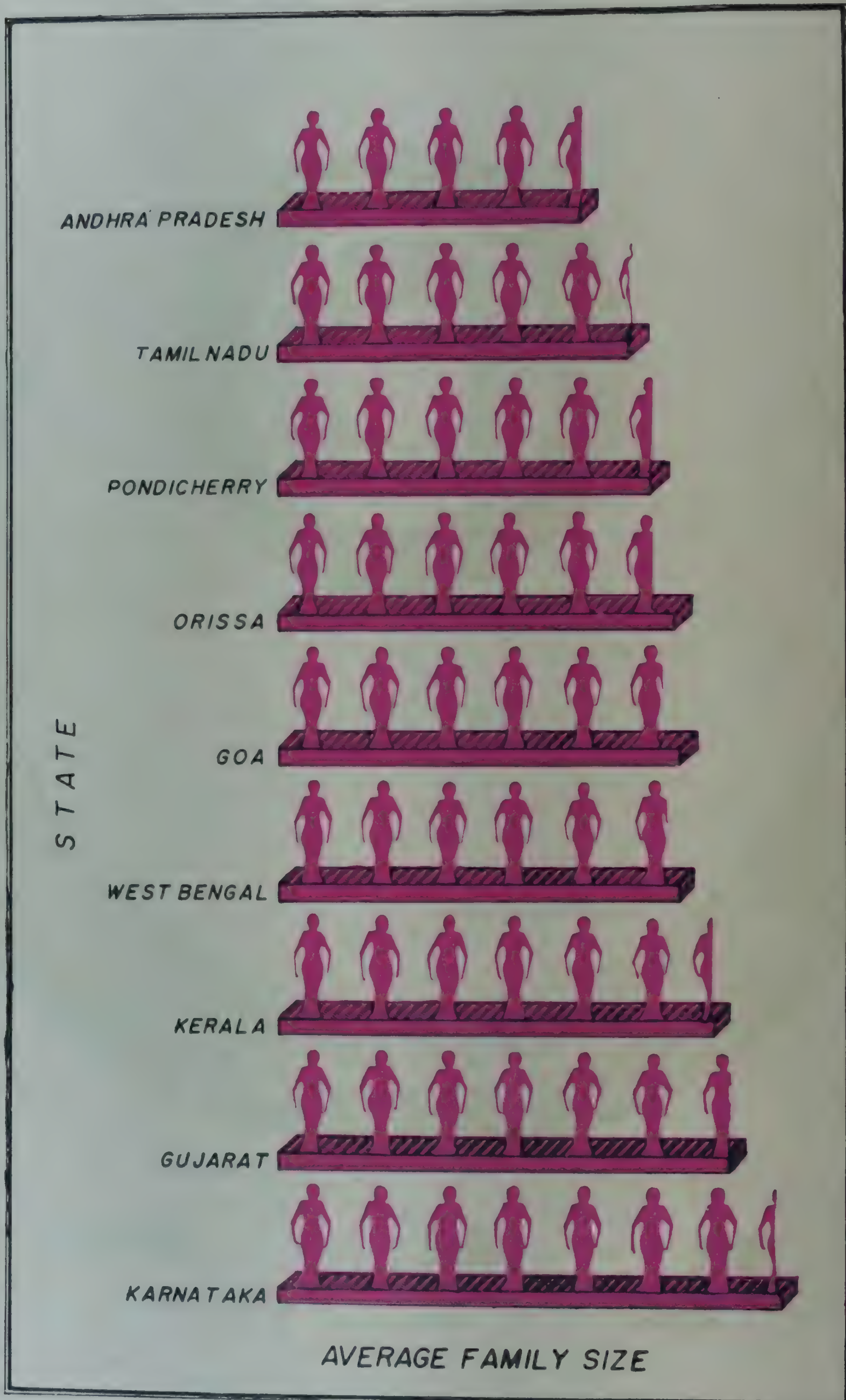

Fig. 2. Statewise average family size of fishermen.

Table 9. *Districtwise figures of marine fishing villages and fishermen population—Tamil Nadu* 1980

Sl. No.	Items	Chengel-pattu	Madras	South Arcot	Thanjavoor	Pudukottai	Ramana-thapuram	Thirunel-veli	Kanyaku-mari	Total
		DISTRICTS								
1.	*No. of fishing villages*	65	37	55	87	20	80	32	46	422
2.	No. of landing centres	65	16	53	84	20	64	28	45	375
3.	No. of fishermen households	7,263	5,662	7,021	15,348	1,539	12,473	7,858	18,557	75,721
4.	*Fishermen population*									
a)	Male	10,426	10,667	11,538	21,782	2,473	21,582	14,559	33,940	1,26,967
b)	Female	10,753	10,337	11,433	22,209	2,285	24,598	13,320	31,756	1,26,691
c)	Children	13,227	12,041	13,506	26,223	3,016	24,963	15,914	33,355	1,42,245
	Total	34,406	33,045	36,477	70,214	7,774	71,143	43,793	99,051	3,95,903
5.	*Educational status*									
a)	Primary	8,394	5,639	7,383	4,496	622	9,676	10,515	13,350	60,075
b)	Secondary	1,761	3,403	2,038	567	72	1,092	773	2,191	11,897
c)	Above secondary	375	300	306	265	17	260	550	1,787	3,860
	Total	10,530	9,342	9,727	5,328	711	11,028	11,838	17,328	75,832
6.	*No. of fishermen engaged in actual fishing*									
a)	Full time	7,722	6,586	8,581	16,884	1,779	14,785	10,363	20,742	87,442
b)	Part time	314	90	133	716	80	430	218	2,039	4,020
c)	Occasional	951	368	413	546	52	345	334	2,029	5,038
	Total	8,987	7,044	9,127	18,146	1,911	15,560	10,915	24,810	96,500

Enumeration work in progress

Table 10. *Districtwise figures of marine fishing crafts and gears—Tamil Nadu* 1980

Sl. No.	Items	DISTRICTS								
		Chengal-pattu	Madras	South Arcot	Thanjavoor	Pudukkottai	Ramanatha-puram	Thirunelveli	Kanyakumari	Total
1.	*No. of fishing crafts*									
a)	*Mechanised*									
	Trawlers	2	96	299	552	36	981	103	226	2,295
	Gillnetters	—	8	—	5	—	27	5	279	324
	Others	—	—	—	2	—	1	—	5	8
	Total	2	104	299	559	36	1,009	108	510	2,627
b)	*Non-mechanised*									
	Dug out canoes	206	18	527	284	9	626	3	537	2,210
	Plank built boats	902	50	197	1,176	908	4,074	958	692	8,957
	Catamarans	7,371	2,287	2,541	5,043	128	370	2,584	11,527	31,851
	Others	83	—	1	195	—	44	1	1	325
	Total	8,562	2,355	3,266	6,698	1,045	5,114	3.546	12,757	43,343
2.	*No. of fishing gears*									
	Trawl nets	10	287	574	1,496	82	3,029	217	524	6,219
	Drift/gill net	8,362	2,107	4,797	22,337	14,479	35,048	14,338	16,832	118,300
	Boat seine	1,273	327	539	2,262	519	24	206	2.070	7,220
	Fixed bag net	525	101	158	168	32	737	12	109	1,842
	Hooks & lines	3,068	519	3,263	4,140	2,756	5,362	487	2,516	22,111
	Shore seine	306	46	211	1,637	57	1,523	66	703	4,549
	Traps	2	7	—	166	4,062	3,312	—	1,370	8,919
	Scoop nets	68	—	252	698	—	22	—	—	1,040
	Others	485	6	3,078	1,571	31	1,168	—	—	6,339

in the districts of Ramanathapuram and Kanyakumari respectively. The percentage of fishermen engaged in part time fishing range from 1% to 8%, the highest and lowest being in Kanyakumari and Madras districts respectively. As regards fishermen engaged in occasional fishing, the maximum is found in Chengalpattu (11%) and the minimum in Ramanathapuram (2%).

Fishing crafts

The total number of mechanised boats owned by the fishermen of Tamil Nadu is about 2,600 consisting of 2,300 trawlers and 300 gill netters. Ramanathapuram district possesses the maximum number (38%). Thanjavoor district comes next (21%) followed by Kanyakumari (19%) and South Arcot (11%). The percentage in other districts is less than 5 each.

In Ramanathapuram district trawlers form 97% and gillnetters 3% and in Thanjavoor the trawlers constitute 99% and gillnetters 1%. However in Kanyakumari district trawlers and gillnetters form 44% and 55% respectively.

A total number of about 43,000 non-mechanised boats is found in Tamil Nadu. Of these, catamarans constitute 73%, plank-built boats and dug-outcanoes forming 21% and 5% respectively. Kanyakumari district possesses the maximum number of non-mechanised boats (29%), the corresponding percentages for the districts of Chengalpattu, Thanjavoor and Madras being 20, 15 and 5 respectively. In all other districts the percentage is less than 5 each.

Catamaran forms the major fishing craft in all the districts except in Pudukottai and Ramanathapuram where plankbuilt boats are predominant. In the districts of South Arcot and Ramanathapuram relatively higher proportions of dug out canoes are noticed.

Fishing gears

There are about 6,200 trawl nets in the state, Ramanathapuram accounting for the maximum (49%) followed by Thanjavoor (24%), South Arcot (9%) and Kanyakumari (8%). Of the different types of non-mechanised gears in the state, drift/gillnet forms the major gear followed by hooks & lines, traps and boat seines. The remaining gears are comparatively less in number.

Drit/gill net forms the dominant gear in all the districts, hooks & lines forming the next important gear except in Pudukottai. Relatively higher proportions of shore seine are seen in the districts of Thanjavoor and Ramanathapuram. Traps constitute an important gear in Pudukottai, Ramanathapuram and Kanyakumari districts.

A comparison of the census data collected in 1980 with those of 1975–76 shows that the number of fishermen population and those engaged in actual fishing increased by 27% and 11% respectively. Kanyakumari district continues to lead both in the total fishermen population and the number of fishermen engaged in actual fishing. The number of indigenous fishing crafts increased by 42%. The number of catamarans increased by 30% and the dug out canoes 28%.

Pondicherry, Karaikal, Mahe and Yenam

The census figures for the Union Territory are given in Tables 11 & 12.

Fishing villages and landing centres

There are 27 fishing villages in the Union Territory the maximum number being in Pondicherry (15) followed by Karaikal (10). In Mahe and Yenam there is only one fishing village each. The number of landing centres is the same as the number of fishing villages.

Population

There are about 4,600 families, Pondicherry accounting for the maximum (62%) followed by Karaikal region (27%). Mahe and Yenam have only 8% and 3% respectively.

The total fishermen population is about 25,300 comprising 29% adult males, 30% adult females and 41% children. Pondicherry and Karaikal regions are the major areas where the fishermen population forms 58% and 27% respectively of their total in the Union Territory. The average family size in the territory works out to 5.5.

Education

Out of the total fishermen population, 19% have completed primary standard, 5% secondary and 1% above secondary standard.

Table 11. *Regionwise figures of marine fishing villages and fishermen population — Union Territory of Pondicherry, Karaikal, Mahe and Yenam* 1980

Sl. No.		Items	Pondicherry	Karaikal	Mahe	Yenam	Total
			REGIONS				
1.		No. of fishing villages	15	10	1	1	27
2.		No. of landing centres	15	10	1	1	27
3.		No. of fishermen households	2,864	1,252	392	117	4,625
4.		*Fishermen population*					
	a)	Male	4,142	2,044	1,054	122	7,362
	b)	Female	4,124	2,156	1,139	125	7,544
	c)	Children	6,506	2,585	1,108	207	10,406
		TOTAL	14,772	6,785	3,301	454	25,312
5.		*Educational status*					
	a)	Primary	3,038	1,375	483	26	4,922
	b)	Secondary	783	493	94	—	1,370
	c)	Above secondary	181	74	15	—	270
		TOTAL	4,002	1,942	592	26	6,562
6.		*No. of fishermen engaged in actual fishing*					
	a)	Full time	2,777	1,491	648	105	5,021
	b)	Part time	137	49	1	—	187
	c)	Occasional	118	143	43	—	304
		TOTAL	3,032	1,683	692	105	5,512

Table 12. *Regionwise figures of marine fishing crafts and gears—Union Territory of Pondicherry, Karaikal, Mahe and Yenam* 1980

Sl. No.		Items	Pondicherry	Karaikal	Mahe	Yenam	Total
			REGIONS				
1.		*No. of fishing crafts*					
	a)	*Mechanised*					
		Trawlers	101	72	3	—	176
		Gillnetters	—	—	—	—	—
		TOTAL	101	72	3	—	176
	b)	*Non-mechanised*					
		Dug out canoes	—	—	72	—	72
		Plank built boats	56	2	—	25	83
		Catamarans	1,049	546	—	—	1,595
		TOTAL	1,105	548	72	25	1,750
2.		*No. of fishing gears*					
		Trawl nets	273	159	5	—	437
		Drift/gill nets	1,203	588	56	4	1,851
		Boat seine	145	158	70	2	375
		Fixed bag net	63	—	—	89	152
		Hooks & lines	438	282	—	—	720
		Shore seine	45	39	—	—	84
		Traps	—	9	—	—	9
		Scoop nets	297	65	—	—	362
		Others	45	75	—	—	120

Fishermen engaged in actual fishing

The number of fishermen engaged in actual fishing forms 22%. Among them, those engaged in full time fishing, part time and occasional form 91%, 3% and 6% respectively. Pondicherry and Karaikal rank first and second in the total number of fishermen who are actually engaged in fishing.

Fishing crafts

In the Union Territory there are 176 trawlers owned

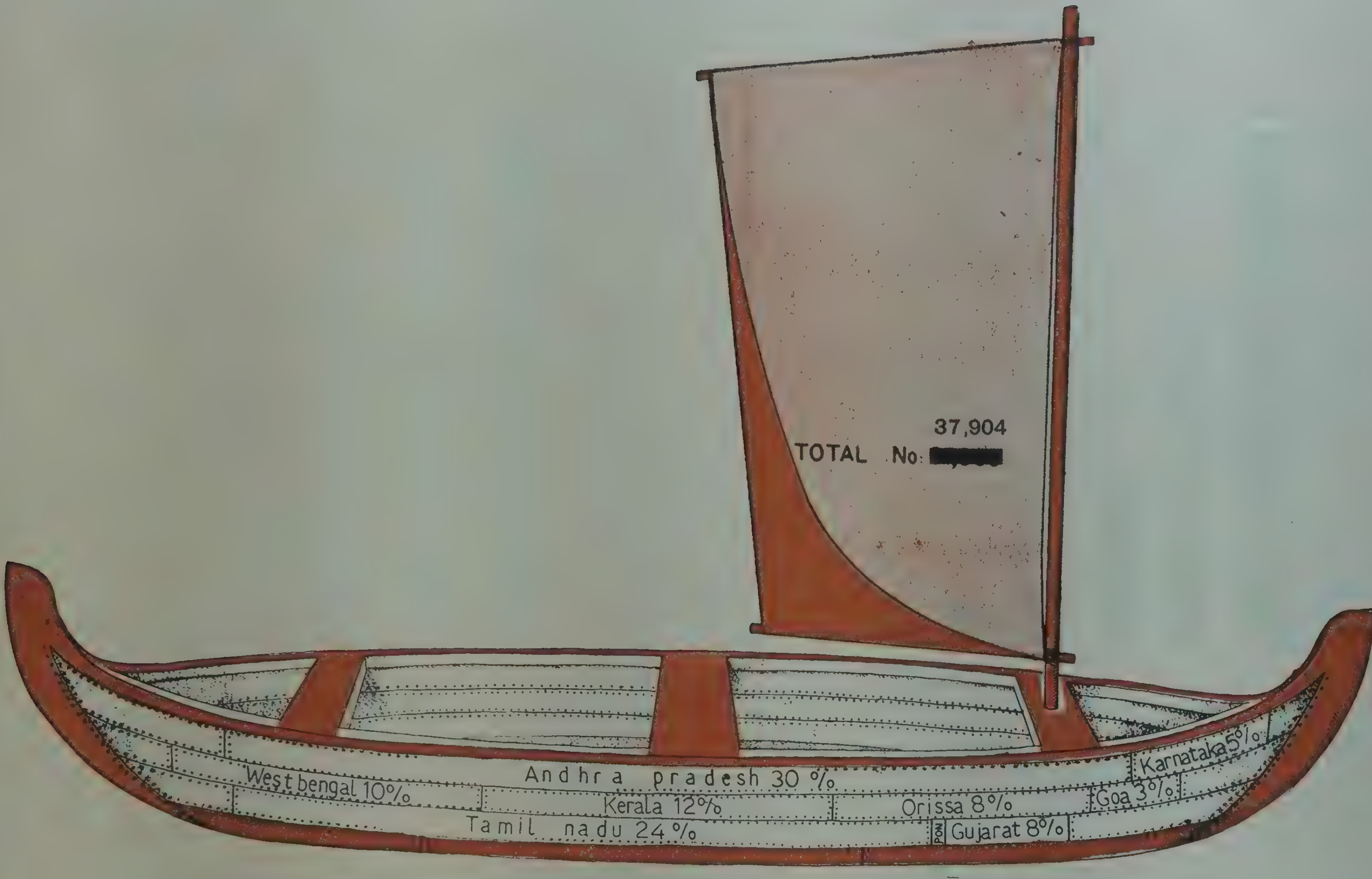

Fig. 3. Distribution of plank-built boats in maritime states

Fig. 4. Statewise distribution of dug out canoes

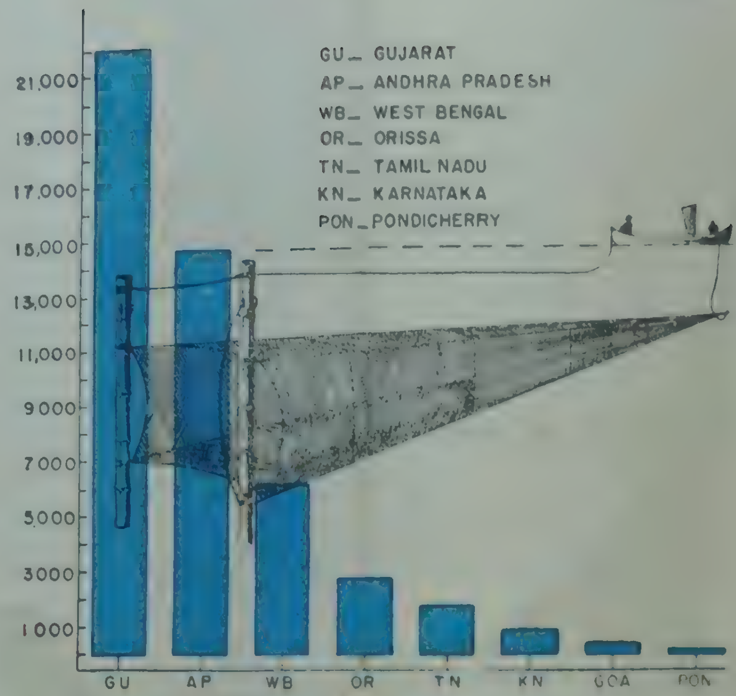

Fig. 5. Distribution of fixed bag nets in maritime states.

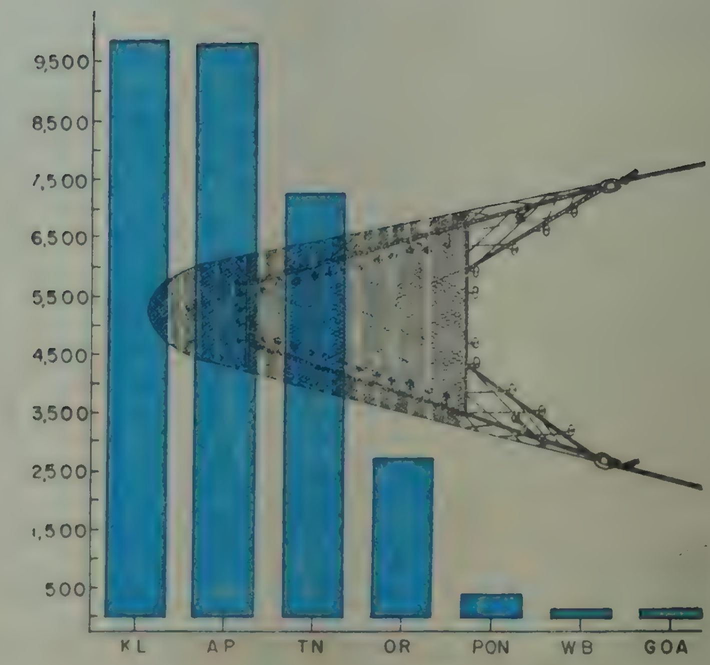

Fig. 7. Distribution of boat seines in maritime states.

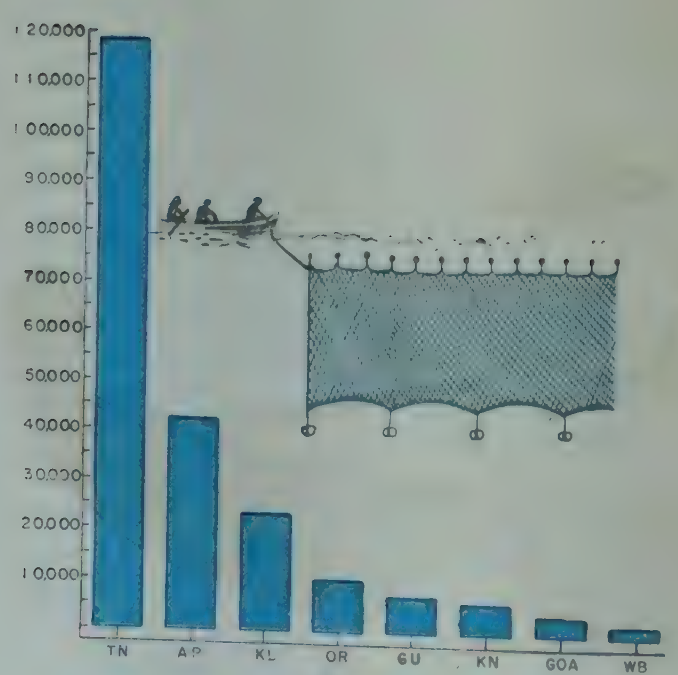

Fig. 6. Statewise distribution of drift/gill nets.

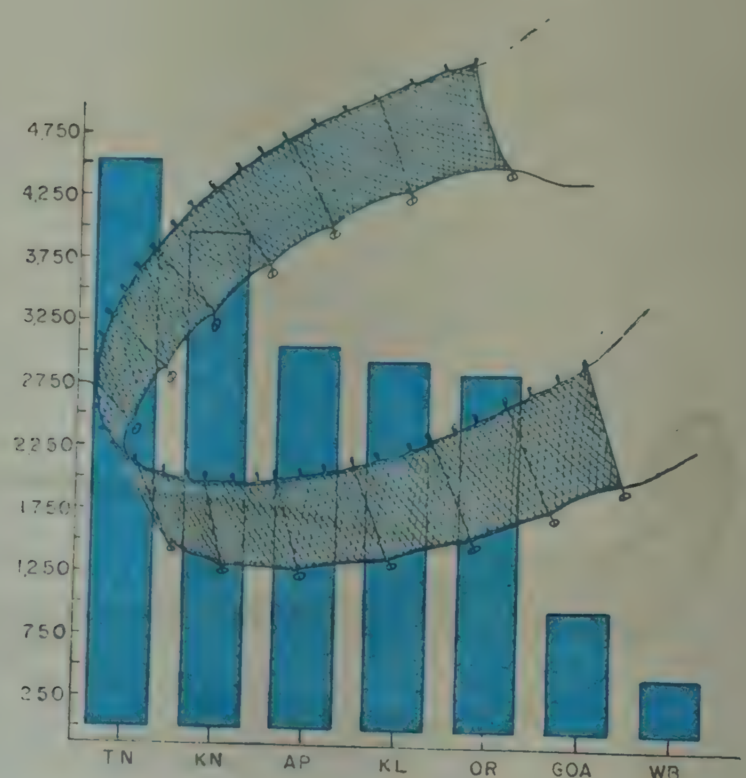

Fig. 8. Statewise distribution of shore seines.

by fishermen of which Pondicherry accounts for 57% and Karaikal 41%. Among 1,750 non-mechanised boats, catamarans contribute 91%, plank-built boats 5% and dug-out canoes 4%.

Fishing gears

There are about 440 trawl nets, Pondicherry and Karaikal having 63% and 36% respectively. Among the non-mechanised gears, drift/gillnet forms the major gear. Hooks and lines, boat seines and scoop nets are the other important gears. In Pondicherry and Karaikal region the drift/gill nets and hooks & lines form the important gears. While boat seine forms the third important gear in Pondicherry and Karaikal, it is the dominant gear in Mahe. In Yenam, however, fixed bagnets are predominant.

Kerala

The census was conducted in 8 coastal districts of Kerala viz. Trivandrum, Quilon, Alleppey, Ernakulam, Trichur, Malapuram, Kozhikode and Cannanore (Tables 13 & 14).

Fishing villages and landing centres

Of the 304 fishing villages in Kerala, the maximum number is found in Cannanore district (65) while Malapuram district has the lowest number (18). This showed an increase of 36 villages from 268 recorded in 1975 census, mostly by increase in Kozhikode and Cannanore districts. There are 222 landing centres in the state. Trivandrum district accounts for the maximum number (24%) while Malappuram districr contributes to the minimum (5%).

Population

The total fishermen population in the state is about 6.4 lakhs. This is 63% more than those recorded in the previous census. Adult males and females form 33% each of the total population, children constituting 34%. The districtwise percentage distribution of the total population ranges from 8 in Ernakulam to 21 in Trivandrum. There are about 1 lakh fishermen families in the state. As in the case of population distribution, the number of fishermen households is highest in Trivandrum district (27%) and lowest in Ernakulam district (8%). In the state as a whole, average size of a fishermen family is 6.4 ranging from 5.0 in Trivandrum to 8.5 in Malappuram.

Education

Those who are literate constitute 23 per cent of the total fishermen population in the state. Out of them 81% completed primary standard, 16% secondary standard and 3% beyond secondary standard.

Fishermen engaged in actual fishing

Twenty per cent of the total fishermen population are engaged in actual fishing. 85% among them are engaged in full time fishing, 8% part time and 7% occasional.

Fishing crafts

There are about 980 mechanised fishing crafts owned by the fishermen families. 76% of these crafts come under the category of trawlers. Gill netters which constitute 22% is the next major category. The maximum number of mechanised crafts is recorded in Quilon district (37%) followed by Ernakulam (16%), Cannanore (15%) and Kozhikode (13%). In all other districts it is less than 7%. 14 crafts recorded under 'others' include liners and carrier boats.

Of the 26,000 non-mechanised crafts, catamarans form 44%, dug-out canoes 40% and plank-built boats the rest. Catamarans are found only in Trivandrum, (90%) and Quilon districts (10%). Plank-built boats are concentrated more in southern districts of Trivandrum, Quilon and Alleppey whereas dug-out canoes are comparatively more in northern districts of Trichur, Malapuram, Kozhikode and Cannanore.

Fishing gears

There are about 1,500 trawl nets owned by fishermen in the state, bulk of which is found in the districts of Quilon (41%), Cannanore (18%), Ernakulam (16%) and Kozhikode (14%). The most commonly used gear in all the districts of Kerala State is drift/gill net. Boat seine is the next important gear found in all the districts. Hooks & lines, traps and scoop nets are mainly concentrated in Trivandrum district. In all the coastal districts of Kerala except in Trivandrum, indigenous fishing operations are mainly carried out either by drift/gill net or by boat seine. But in Trivandrum district, fishing activity is more diversified with the use of various types of gears such as drift/gill nets, shore seines, boat seines, scoop nets and traps. Among the gears given under 'others', cast nets constitute a major portion.

Table 13. *Districtwise figures of marine fishing villages and fishermen population—Kerala* 1980

Sl. No.	Items	DISTRICTS								Total
		Trivandrum	Quilon	Alleppey	Ernakulam	Trichur	Malappuram	Kozhikode	Cannanore	
1.	No. of fishing villages	54	29	39	20	22	18	57	65	304
2.	No. of landing centres	54	33	34	13	19	12	24	33	222
3.	No. of fishermen households	26,519	12,381	15,648	7,648	8,295	8,321	11,884	9,148	99,894
4.	Fishermen population									
	Male	43,848	27,615	33,026	16,931	19,655	19,888	26,320	23,326	2,10,609
	Female	41,737	25,662	33,105	17,098	20,421	22,366	26,157	23,307	2,09,853
	Children	46,502	25,836	31,257	15,030	20,356	28,650	26,957	24,822	2,19,410
	Total	1,32,087	79,113	97,388	49,059	60,432	70,904	79,434	71,455	6,39,872
5.	Educational status									
	Primary	23,566	19,056	19,170	14,633	13,845	5,435	13,154	10,964	1,19,823
	Secondary	2,009	3,611	9,410	3,174	1,099	345	1,133	2,733	23,514
	Above secondary	900	1,258	1,181	415	397	44	364	758	5,317
	Total	26,475	23,925	29,761	18,222	15,341	5,824	14,651	14,455	1,48,654
6.	No. of fishermen engaged in actual fishing									
	Full time	20,882	12,115	19,365	7,768	10,186	12,944	16,005	12,705	1,11,970
	Part time	5,115	875	904	1,862	720	425	435	681	11,017
	Occasional	3,116	982	872	586	700	577	609	672	8,114
	TOTAL	29,113	13,972	21,141	10,216	11,606	13,946	17,049	14,058	1,31,101

Table 14. *Districtwise figures of marine fishing crafts and gears—Kerala* 1980

Sl. No.	Items	DISTRICTS								Total
		Trivandrum	Quilon	Alleppey	Ernakulam	Trichur	Malappuram	Kozhikode	Cannanore	
	No. of Fishing crafts									
a)	Mechanised									
	Trawlers	13	319	32	133	27	12	90	119	745
	Gill netters	18	45	8	22	34	43	34	11	215
	Purse seiners	—	—	—	—	—	—	—	9	9
	Others	—	—	1	4	—	2	—	7	14
	Total	31	364	41	159	61	57	124	146	983
b)	Non-Mechanised									
	Plank built boats	911	760	1,442	265	112	597	287	2	4,376
	Dug out canoes	1,282	680	735	1,198	1,411	1,416	1,907	1,786	10,415
	Catamarans	10,302	1,178	—	—	—	—	—	—	11,480
	Total	12,495	2,618	2,177	1,463	1,523	2,013	2,194	1,788	26,271
	No. of fishing Gears									
	Trawl nets	22	593	59	229	45	30	209	267	1,454
	Purse seines	—	—	—	—	—	—	—	9	9
	Drift/gill nets	10,236	3,764	1,635	1,620	1,787	545	1,770	1,950	23,307
	Boat seines	2,648	774	1,385	435	683	1,038	1,587	1,229	9,779
	Hooks & lines	2,133	157	130	37	60	101	163	168	2,949
	Shore seines	1,150	657	431	197	85	125	137	144	2,926
	Traps	2,195	44	—	—	—	—	—	—	2,239
	Scoop nets	1,209	33	—	74	—	43	5	7	1,371
	Others	500	69	425	740	307	—	602	118	2,761

Karnataka

The census was carried out in South Kanara and North Kanara, the coastal districts of Karnatka. Tables 15 & 16 give the districtwise distribution of marine fishermen population and crafts and gears.

Fishing villages and fish landing centres

There are 147 fishing villages spread along Karnataka coast, 77 villages in South Kanara and 70 in North Kanara. Fish landings take place in 55 landing centres in South Kanara while there are 50 centres in North Kanara district.

Table 15. *Districtwise figures of marine fishing villages and fishermen population—Karnataka* 1980

Sl. No.	Item	DISTRICTS		
		South Kanara	North Kanara	Total
1.	No. of fishing villages	77	70	147
2.	No. of landing centres	55	50	105
3.	No. of fishermen households	8,992	6,646	15,638
4.	*Fishermen population*			
a)	Male	20,544	12,171	32,715
b)	Female	23,070	11,818	34,888
c)	Children	27,214	18,076	45,290
	TOTAL	70,828	42,065	1,12,893
5.	*Educational status*			
a)	Primary	13,752	7,844	21,596
b)	Secondary	4,077	1,097	5,174
c)	Above secondary	1,237	316	1,553
	TOTAL	19,066	9,257	28,323
6.	*Fishermen engaged in actual fishing*			
a)	Full time	9,502	8,162	17,664
b)	Part time	4,014	1,544	5,558
c)	Occasional	975	808	1,783
	TOTAL	14,491	10,514	25,005

Table 16. *District-wise figures of marine fishing crafts and gears—Karnataka* 1980

Sl. No.	Item	DISTRICTS		
		South Kanara	North Kanara	Total
1.	*Fishing crafts*			
a)	*Mechanised*			
	Trawlers	454	354	808
	Purse seiners	110	63	173
	Gill netters	16	7	23
	Carrier boats	65	2	67
	Others	2	5	7
	TOTAL	647	431	1,078
b)	*Non mechanised*			
	Dug out canoes	2,225	2,229	4,454
	Plank built boats	11	1,736	1.747
	Catamarans	4	19	23
	Others	29	689	718
	TOTAL	2,269	4,673	6,942
2.	*Fishing Gears*			
	Trawl nets	945	843	1,788
	Purse seines	121	67	188
	Fixed bag net	84	857	941
	Boat seines	1	22	23
	Drift/gill net	1,130	5,441	6,571
	Hooks and lines	300	1,207	1,507
	Rampans	24	62	86
	Shore seines	2,990	934	3,924
	Others	4,470	6,455	10,925

Population

There are about 15,600 fishermen households in the state, 58% of them being in South Kanara district. There are 1.13 lakh marine fishermen population in the state, of which 63% are in South Kanara district. In the state, 60% of the population are adults, 29% males, and 31% females. In South Kanara district 29% are adult males, 33% adult females and 38% children and in North Kanara district males form 29%, females 28% and children 43%. Average size of the family in the state is 7.2.

Education

Nineteen per cent of the marine fishermen population have received education at primary level, 5% at secondary level and only 1% above secondary level.

Fishermen engaged in actual fishing

Twenty two per cent of the fishermen in the state are engaged in actual fishing activities, 16% full time, 5% part time and 1% occasional. In South Kanara district 20% are engaged in actual fishing; 13% full time, 6% part time and 1% occasional. In North Kanara 19% are engaged in full time fishing, 4% part time and 2% occasional.

Fishing crafts

There are about 800 trawlers owned by the fishermen of the State of which 56% are in South Kanara district. In South Kanara there are 110 purse-seiners owned by fishermen while in North Kanara there are 63. Apart from these, there are 67 carrier boats and 23 gill netters.

There are about 4,500 dug-out canoes in the state evenly distributed in the two districts. Out of about 1,750 plank-built boats the majority are in North Kanara district.

Fishing gears

Out of about 1,800 trawlnets in the state owned by the fishermen, 53% are possessed by fishermen of South Kanara. There are about 6,600 drift/gill nets in the state, 83% of them being in North Kanara district. Out of 86 Rampans recorded, 62 are in North Kanara and 24 in South Kanara. Among 4,000 shore seines other than Rampans, 76% are in South Kanara district.

Goa, Daman and Diu

Census was carried out in the Union Territory of Goa, Daman and Diu (Tables 17 & 18).

Table 17. *Districtwise figures of marine fishing villages and fishermen population—Goa—1980*

		DISTRICT			
Sl. No.	Item	Goa	Daman	Diu	Total
1.	No. of fishing villages	47	5	9	61
2.	No. of landing centres	46	5	3	54
3.	No. of fishermen households	3,380	1,057	2,288	6,725
4.	*Fishermen population*				
a)	Male	6,429	1,898	4,132	12,459
b)	Female	5,991	1,932	4,475	12,398
c)	Children	6,812	2,594	5,649	15,055
	TOTAL	19,232	6,424	14,256	39,912
5.	*Educational status*				
a)	Primary	4,302	565	2,193	7,060
b)	Secondary	1,793	65	759	2,617
c)	Above secondary	210	29	99	338
	TOTAL	6,305	659	3,051	10,015
6.	*Fishermen engaged in actual fishing*				
a)	Full time	3,678	1,041	2,122	6,841
b)	Part time	651	106	605	1,362
c)	Occasional	336	51	281	668
	TOTAL	4,665	1,198	3,008	8,871

Table 18. *Districtwise figures of marine fishing crafts and gears—Goa* 1980

Sl. No.		Item	DISTRICT			
			Goa	Daman	Diu	Total
1.		*Fishing crafts*				
	a)	*Mechanised*				
		Trawlers	231	29	147	407
		Purse seiners	39	—	—	39
		Gill netters	46	124	43	213
		Others	—	—	—	—
		TOTAL	316	153	190	659
	b)	*No-nmechanised*				
		Dug out canoes	1,054	59	284	1,397
		Plank built boats	1,006	67	35	1,108
		Others	6	—	2	8
		TOTAL	2,066	126	321	2,513
2.		*Fishing Gears*				
		Trawl nets	306	44	422	772
		Purse seines	41	—	—	41
		Fixed bag nets	73	140	217	430
		Boat seines	109	—	56	165
		Drift/gill nets	2,293	641	412	3,346
		Hooks and lines	127	—	—	127
		Rampans	101	—	—	101
		Shore seines	259	—	728	987
		Others	1,597	780	436	2,813

Fishing villages and landing centres

There are 61 fishing villages in the territory, 47 in Goa, 5 in Daman and 9 in Diu. Out of 54 landing centres in the territory, 46 are in Goa, 5 in Daman and 3 in Diu.

Population

Out of 6,700 fishermen households in the territory, 50% are in Goa, 16% in Daman and 34% in Diu. The marine fishermen population in the Territory is about 40,000, 48% in Goa, 16% in Daman and 36% in Diu. Average size of the family in the territory is 5.9. Among the fishermen population in the territory 31% each are adult males and females and 38% children. The same pattern is observed in the districts also.

Education

In the territory 18% of the population have received education at primary level, 7% at secondary level and 1% above secondary level.

Fishermen engaged in actual fishing

Twentytwo per cent of the population are engaged in actual fishing; 17% full time, 3% part time and 2% occasional. In Goa district, 24% are engaged in actual fishing; 19% full time, 3% part time and 2% occasional. 19% of the population in Daman are engaged in actual fishing; 16% full time, 2% part time and 1% occasional. In Diu district, 21% are engaged in actual fishing; 15% full time, 4% part time and 2% occasional.

Fishing crafts

Fishermen of the territory possess 407 trawlers of which 57% are in Goa district, 7% in Daman and 36% in Due. 39 purse-seiners recorded in the territory belong to fishermen of Goa district. Out of 213 gill netters owned by the fishermen in the territory, 22% are in Goa district, 58% in Daman and 20% in Diu.

There are 2,500 non-mechanised crafts in the territory of which 55% are dug-out canoes and 44% plank built boats. 75% of the dug out canoes and 91% of the plank-built boats are in Goa district. 20% of the dug out canoes are in Diu and only 4% in Daman. 6% of the plank-built boats are in Daman and only 3% in Diu district.

Fishing gears

There are 772 trawl nets and 41 purse seines owned by the fishermen. 55% of the trawlnets are in Diu

district, 40% in Goa and 5% in Daman. All the 101 Rampans are confined to Goa. Out of 3,350 drift/gill nets, 69% are in Goa district, 19% in Daman and 12% in Diu. Shore seines other than Rampans are mostly found in Diu (74%).

Gujarat

The enumeration work in this state was carried out in two stages. In the districts except Kutch area it was conducted in June–July 1980. Since the Kutch-Bhuj district remained cut off for a long period due to heavy rains and floods, the census work in this area was put off and was taken up only in May–June 1981. The census was carried out in the districts of Valsad, Surat, Baruch, Kheda, Bhavanagar, Amreli, Junagadh, Jamnagar, Rajkot and Kutch. The details of census figures are shown in Tables 19 and 20.

Fishing villages and landing centres

There are 179 fishing villages with almost same number of landing centres. Out of the fishing villages, 29% are in Kutch, 23% in Valsad, 12% in Junagadh, 11% in Jamnagar and 8% in Surat. The rest of the districts accounts for less than 7% each. The number of landing centres also followed more or less the same pattern.

Population

The total fishermen population is about 1.5 lakh, Valsad accounting for 39%, Junagadh 28% and the remaining 8 districts less than 10% each. Of the total population, adult males and females constitute 28% each and the rest are children. There are about 23,000 fishermen households in the state. Valsad district is having the maximum number of families (39%) followed by Junagadh (26%) and Amreli (10%). Average size of a fishermen family is 6.6.

Education

Sixteen per cent of the population completed primary standard, 3% secondary standard and less than 1% continued above secondary.

Fishermen engaged in actual fishing

About 24% of the fishermen population are engaged in actual fishing. Out of these, 70% belong to full time category, 19% part time and the remaining 11% do fishing only occasionally.

Fishing crafts

There are about 2,900 mechanised boats owned by the fishermen families, nearly half of them trawlers. Gill netters constitute 42%. Mechanised boats are concentrated more in Junagadh, Valsad and Amreli coasts. These 3 districts together contribute 96% of the total mechanised boats.

There are about 4,100 non-mechanised crafts of which 74% are plank-built boats and the rest dug-out canoes. Plank built boats are recorded more in Kutch, Valsad, Jamnagar, Rajkot and Junagadh. Comparatively more number of dug out canoes are seen in Valsad, Junagadh and Amreli districts.

Fishing gears

There are about 2,700 trawl nets owned by the fishermen. Regarding non-mechanised gears, fixed bag net is the most popular one which is used in all the districts. Dol nets form the major constituent of the fixed bag nets. Valsad is having the maximum number closely followed by Surat. Junagadh and Valsad districts together contribute about 63% of the drift/gill nets. Hooks and lines are mostly operated in Surat and Valsad districts. A large number of traps *(fanse)* are found in Baruch district. These traps are small contraptions meant for capturing gobids found in the marshy exposed coast of the district.

General remarks

Among the maritime states, the maximum fishermen population is found in Kerala. The number of fishermen per km coast line is the highest in Kerala (1,143) followed by Karnataka (418), Tamil Nadu (396), Andhra Pradesh (336), Goa (261), Orissa (244), West Bengal (139) and Gujarat (125). In general among the adult population, proportion of males to females is found to be 1:1 in all the states except in West Bengal (1.2:1), Orissa (1.1:1) and Karnataka (1:1.1). The number of persons per family for the whole of India works out to 5.7. Among the states, Karnataka records the maximum (7.2), other states where the family size exceeds the all India average being Gujarat (6.6), Kerala (6.4), West Bengal and Goa (5.9 each). However, in the states of Andhra Pradesh (4.5),Tamil Nadu (5.2) and Pondicherry (5.5) the family size is less than the all India figure.

In educational status, the percentage of persons completed at least primary standard is above the all India level (19) in the states of Goa (26), Karnataka (25), Pondicherry (25), Kerala (24), West Bengal (23),

Table 19. *Districtwise figures of marine fishing villages and fishermen population—Gujarat* 1980

Sl. No.	Item	DISTRICTS										
		Valsad	Surat	Baruch	Kheda	Bhavnagar	Amreli	Junagadh	Jamnagar	Rajkot	Kutch	Total
1.	No. of fishing villages	41	15	12	1	4	8	22	20	5	51	179
2.	No. of landing centres	39	15	11	1	4	7	16	21	8	51	173
3.	No. of fishermen households	9,055	1,361	926	82	197	2,233	6,105	1,157	841	1,118	23,075
4.	Fishermen population											
a)	Male	18,487	2,719	1,561	119	315	3,649	10,545	2,211	1,173	2,056	42,835
b)	Female	17,478	2,737	1,478	109	289	3,925	10,774	2,196	1,176	2,087	42,249
c)	Children	22,989	2,984	2,369	208	575	6,985	21,524	3,691	2,309	3,297	66,931
	TOTAL	58,954	8,440	5,408	436	1,179	14,559	42,843	8,098	4,658	7,440	1,52,015
5.	Educational status											
a)	Primary	13,170	2,815	285	6	79	896	6,502	67	6	75	23,901
b)	Secondary	2,158	1,052	32	—	7	147	663	1	—	7	4,067
c)	Above secondary	705	112	4	—	—	27	63	—	—	—	911
	Total	16,033	3,979	321	6	86	1,070	7,228	68	6	82	28,879
6.	No. of fishermen engaged in actual fishing											
a)	Full time	8,345	994	997	73	119	2,619	8,101	1,582	1,146	1,640	25,616
b)	Part time	1,760	445	94	9	216	130	2,731	174	1,087	195	6,841
c)	Occasional	3,332	515	51	—	1	10	94	8	—	59	4,070
	TOTAL	13,437	1,954	1,142	82	336	2,759	10,926	1,764	2,233	1,894	36,527

Table 20. *Districtwise figures of marine fishing craft and gears—Gujarat,* 1980

Sl. No.	Items	Valsad	Surat	Baruch	Kheda	Bhav-nagar	Amreli	Junagadh	Jamnagar	Rajkot	Kutch	Total
		DISTRICTS										
1.	No. of fishing crafts											
a)	Mechanised											
	Trawler	348	—	—	—	—	117	900	28	—	17	1,410
	Gill netter	285	3	—	—	1	93	790	51	—	2	1,225
	Dol netter	99	—	—	—	—	51	91	—	—	—	241
	Others	18	—	—	—	—	—	—	—	—	—	18
	Total	750	3	—	—	1	261	1,781	79	—	19	2,894
b)	Non-mechanised											
	Plank built boats	658	136	160	—	—	90	233	586	504	673	3,040
	Dug out canoe	442	—	56	—	7	172	304	40	—	59	1,080
	TOTAL	1,100	136	216	—	7	262	537	626	504	732	4,120
2.	No. of fishing gears											
	Trawl net	614	—	—	—	—	222	1,760	51	—	25	2,672
	Drift/gill nets	2,253	464	313	3	25	448	2,427	562	575	313	7,383
	Fixed bagnets	5,177	4,964	2,375	—	120	688	1,066	13	4,121	3,333	21,857
	Hooks & lines	662	1,131	260	40	38	—	226	13	—	6	2,376
	Traps	729	673	85,550	—	—	—	—	—	—	—	86,952
	Others	12,157	1,882	804	35	742	597	2,045	3,716	2,973	3,062	28,013

Gujarat (20) and Tamil Nadu (19). But in Orissa (10) and Andhra Pradesh (8) the percentage was far below the all India level.

The percentage of fishermen (around 23) engaged in actual fishing is more or less the same in all the states. Among them, the percentage of fishermen engaged in full time fishing ranges from about 70 to 90 in all the states except in West Bengal (47). This can be attributed to a sizeable number of them having fishing as seasonal occupation.

The maximum number of landing centres per 100 km of coast line is noticed in Kerala (40) followed by Karnataka (39), Andhra Pradesh (39) and Tamil Nadu (38). But in the states of Gujarat (14), Orissa (12) and West Bengal (9) the number is considerably low.

The total number of mechanised boats in the country is about 19,000 (Table 21). Excluding Maharashtra, Andamans and Lakshadweep the total number of mechanised boats is about 14,000 of which 68% are trawlers and 23% gill netters. The maximum number of mechanised boats is found in Gujarat (24%) followed by Kerala (22%), Tamil Nadu (20%), Karnataka (14%) and the remaining 5 states having less than 6% each. The total number of trawlers in Kerala and Tamil Nadu accounts for 27% each followed by Karnataka (16%), Gujarat (13%) and the remaining 5 states having less than 5% each. Most of the purse-seiners are found in Karnataka. Of the 14,000 mechanised boats, 66% are owned by the fishermen mostly on share basis.

Out of about 38,000 plank built boats, 30% are found in Andhra Pradesh, 24% in Tamil Nadu, 12% in Kerala and 10% in West Bengal. In the remaining five states they constitute less than 10% each. In the case of catamarans Tamil Nadu (43%) leads followed by Andhra Pradesh (30%) and Kerala (16%). Kerala ranks first with 48% of total dug-out canoes, Karnataka coming second (21%) followed by Tamil Nadu (10%) and Andhra Pradesh (8%).

Out of 2.16 lakh drift/gill nets, Tamil Nadu accounts for 55%, Andhra Pradesh 20%, Kerala 11% and the other six states less than 5% each. As regards 49,000 fixed bag nets, Gujarat has 45%, Andhra Pradesh 30% and West Bengal 13%. Almost 90% of total number of boat seines are found in the states of Kerala (33%), Andhra Pradesh (33%) and Tamil Nadu (24%).

The enormous number of fishermen engaged in actual fishing and the extent of crafts and gears employed by them as indicated by the present census would indicate the magnitude of the fishing activities in the marine sector in the country. It is hoped that this enumeration will be helpful in viewing the activities of this sector in the proper perspective for future planning and development.

Table 21. *Statewise number of mechanised boats which are in operation in India*

Sl. No.	State	Trawlers	Gill netters	Purse seiners	Dol netters	Others	Total
1.	West Bengal	—	740	—	—	—	740
2.	Orissa	350	119	—	—	—	469
3.	Andhra Pradesh	580	—	—	—	—	580
4.	Tamil Nadu	2,614	143	—	—	—	2,757
5.	Pondicherry	160	3	—	—	—	163
6.	Kerala	2,630	362	37	—	9	3,038
7.	Karnataka	1,553	28	325	—	98	2,004
8.	Goa	494	274	66	—	74	908
9.	Gujarat	1,209	1,547	—	650	7	3,413
	Total (Excluding Maharashtra, Andamans & Lakshadweep)	9,590	3,216	428	650	188	14,072
	Andamans*						10
	Lakshadweep*						213
	Maharashtra*						4,718
	ALL INDIA						19,013

* Source: Indian Fisheries—1947–77.

APPENDIX

List of scientific and technical staff of C.M.R.F.I. who participated in the census programme.

1. Fishery Resources Assessment Division

Shri T. Jacob, Scientist S.3
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,, V. Rajendran ,,
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,, S. Haja Najumudeen, Computor T.2
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,, Ahamed Kamal Basha ,,
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Shri K. Ramadoss ,,
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,, G. Subbaraju, Scientist S.2
Dr. K. Radhakrishna, Scientist S.2
Shri S. Muthusamy Scientist S.1
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,, M. Rajagopalan ,,
,, C. V. Mathew, Scientist S
,, P. Mojumdar, Field Officer T.7
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,, K. Ramachandran Nair, Technical Assistant T.II.3
,, K. P. Viswanathan, Junior Technical Assistant T.2
,, J. R. Ramalingam ,,
,, M. Najumuddin ,,
,, P. M. Aboobacker ,,
,, C. H. Ellithathayya, Field Assistant T.1
,, P. D. Solanki

BOOKS

The Chemical biology of fishes: Volume 2. By R. Malcolm Love, Academic Press, London, pp 944, 1980.

This book is a continuation of the survey begun in Volume 1 on the Chemical biology of fishes published in 1970. Factors which influence the chemical composition of fish are reviewed and a lengthy key to the chemical literature is included so that papers giving the concentration of specific substances in different organs of many species of fish can be identified at a glance.

The two volumes are designed to be used together. As biologists are tending to use a more biochemical approach and biochemists are becoming more interested in fish, the overall approach is now more biochemical. Distinctions are drawn between the biochemistry of fish and that of warm-blooded animals. The final chapter considers how the biologist can use chemistry as a tool to assess the biological condition of fish and their potential as food for man, making it quite novel. While some suggested methods are speculative, a number of new approaches emerge and these should stimulate advances in the field of fish biology. The book will be of considerable interest to fisheries research laboratories, biology and biochemistry departments, fish culture establishments and commercial fish farms.

Tuna fishing with pole and line: Edited by M.Ben-Yami Fishing News Books Ltd., England, pp. 150, 1980.

This manual attempts to provide information and advice to those fishermen, fishing technologists, fishing instructors and extension workers for whom such pole and line fishing is new, as well as for those who wish to improve their present techniques. It is well illustrated covering the chapters viz vessels, live-bait fishing techniques, handling and transport of live-bait, tuna fishing gear and auxiliary equipment, fishing operation and handling fish on board.

Fish population dynamics: By George V. Nikolskii. Translated by Dr. J.E.S. Bradley, Ed. by R. Jones. Bishen Singh Mahendra Pal Singh, Dehra Dun and Otto Koeltz Science Publishers, Koenigstein (W. Germany), pp. 323, 1980.

This is the English translation of the Russian book. The book starts with a brief introduction followed by a discussion of the main process that influence fish population dynamics: Food supply, breeding, development and growth, natural and fishing mortality. It has a chapter on biological principles of the mathematics of fish population dynamics. The last two chapters deals with some of the practical conclusions that emerge from the study of population dynamics as regards forecasting catches and raising the productivity of commercial fish populations. Finally the author presents some views on future problems as regarding the theory of fish population dynamics.

Diseases of Marine Animals: Vol. I: *General aspects—Protozoa to Gastropoda:* Edited by Otto Kinne. John Wiley & Sons, New York. pp. 466, 1980.

This is the first volume of the series. The book reviews comprehensively and critically all essential information available to date on the biotic diseases, proliferative disorders and structural abnormalities of marine animals. This book corrects numerous misquotations which have found their way into the scientific literature over the years. Topical emphasis is placed on a detailed documentation of the types and causes of the diseases of marine animals (from the protozoa via the Invertebrate to the Aves and Mammalia), the significance of diseases as an ecological and evolutionary phenomenon and the importance of disease for organismic performance, with a special view on experimental ecology and aquaculture.

Compiled and prepared by M. J. George, S. K. Dharmaraja & G. Subbaraju.
Published by Dr. M. J. George, Senior Scientist on behalf of the Director, Central Marine Fisheries Research Institute, Cochin-682 018 and printed at PAICO, Cochin-31

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Cover photo: Mechanised vessel landing centre at Malpe, Karnataka.

COMMERCIAL TRAWL FISHERIES OFF KAKINADA DURING 1969-1978*

Introduction

Experimental and exploratory trawling off Kakinada by the Central and State Government organisations was initiated in 1960 but the commercial exploitation of the resources by small-sized trawlers started in 1964. Since then, the industry expanded substantially by increasing both the size and number of the trawlers. The staff attached to the Research Centre at Kakinada have been collecting data in a systematic way on various resources, since the beginning of commercial trawling at Kakinada, to understand the resource characteristics and also to provide the data to various organisations and enterpreneurs interested in the same. The data collected during the 10 year period (1969–1978) are incorporated in this report.

Presently the fishing is conducted in the sea off Kakinada between 16° 35′ N–17° 25′ N latitude and 82° 20′ E–83° 10′ E longitude (fig. 1) at depths ranging from 5 to 80 m. During the earlier years however,

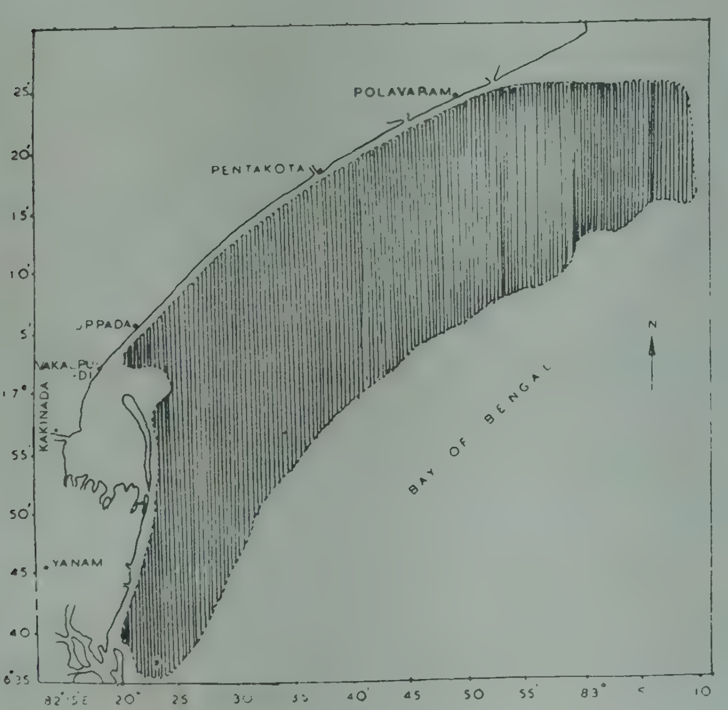


Fig. 1. Map of fishing ground.

the area covered was less (vide:Muthu *et al.*, *Indian J. Fish.*, 22; 1975.) The boats conduct daily fishing during day time and land the catches by evening but during certain months (November–February) some boats conduct night fishing also and land the catches in the early morning.

Craft and Gear

Three types of boats are engaged in fishing in the region. The particulars of the sizes of the boats, engine and the nets used are given in Table 1. The commercial fishery started with small boats *(Pablos)* and subsequently boats of two more sizes were added to the fleet (Table 1) but there was considerable increase in the *Pomfret* and *Royya* boats over the years, whereas similar increase was not noticed for *Pablos* and *Sorrahs* (fig. 2).

Fisheries

Data on the catches collected over a period of ten years from 1969 to 1978 (Table 2) show that on an average 6,691 tonnes of fish including 1,666 tonnes of

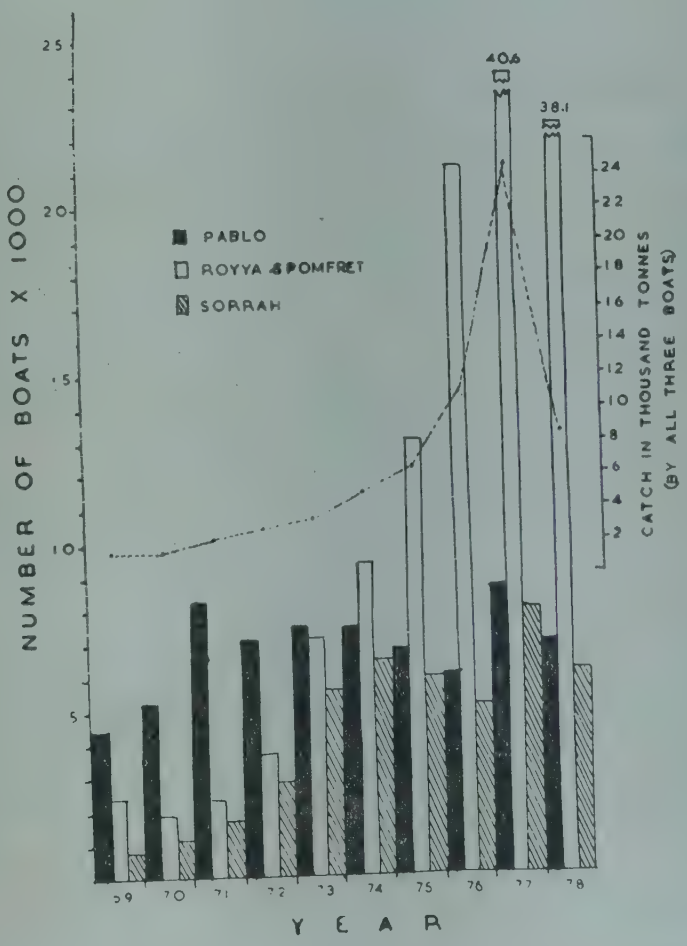


Fig. 2. Details of types of boats operated in different years and estimated total catches.

prawns are landed at this centre annually. There are differences in the seasonal variations of the ground fish abundance on the trawling grounds in different years

* Prepared by the staff of Kakinada Research Centre of CMFRI

Table 1. *Details of the Craft and Gear used at Kakinada.*

Type of Boat	Particulars of the vessels				Particulars of the gear operated					
	Length	Beam	Draft	Engine	Type of net	Length of Head rope	Mesh size	Otter boards	Rigging	Net operation
	m	m	m	HP			cm			
Pablo	9.14	2.49	0.87–0.97	20–30	2-seam cotton trawl during earlier years 2-seam and 4-seam trawl made of synthetic monofilament of 0.5–1.0 mm diameter.	11.89 & 12.95 m	Wings: 7.6 Body: 3.8–5.1 cod end 0.8–2.5	Shape: oval during early periods Flat Rectangular now. Wt: 35 kg.	Double expanded legs upto a length of 5–10 m	Mechanical winch with G.I. wire rope.
Pomfret & Royya	9.75 & 10.0	2.9	1.07	45–60	–do–	14.94, 16.5 and 18.29 m In some cases the wings are extended even up to 27.44 m to cover wider area.	–do–	Wt: 40–45 kg.	–do– with a length of 15–20 m.	–do–
Sorrah	11.41	3.2	1.22	60–75	–do–	–do–	–do–	Wt: 45–60 kg.	–do– with a length of 10–20 m.	–do–

but a peak in January–March period is more or less common to all years (Table 3). Several species contribute to the fishery and the data are collected by separating the catches into 33 groups as given in Table 2. Of these, prawns, sciaenids, ribbon fish, silver bellys, *Decapterus* sp, *Nemipterus* spp, *Psenes* sp, Lizard fish, Bombay Duck and flat fish are the dominant items (in the order of abundance) in the catches. The seasonal variations in the catches of these ten groups for the period 1969–78 (averages) are presented in Table 4.

Prawns

Prawns form the most dominant component in the trawl catches accounting for about 25% of the total catches (Table 2). 30 species of penaeid prawns and 7 species of non-penaeid prawns contribute to the fishery. Important species of penaeid prawns in the order of abundance are: *Metapenaeus dobsoni, M. monoceros, M. affinis, Penaeus indicus, P. monodon, Parapenaeopsis stylifera, Solenocera crassicornis, P. hardwickii* and *P. merguiensis*. Among non-penaeid species, *Acetes* spp, *Exopalaemon styliferus, Nematopalaemon tenuipes* and *Exhippolysmata ensirostris* are important. The details regarding the prawn fisheries at Kakinada during the study period have been reported by Sudhakara Rao *et al. (Mar. Fish. Infor. Serv. T & E Ser.*, No. 21, 1980).

Sciaenids

These fishes occupy second position in regard to abundance. The catches showed an increasing trend till 1972; in 1973 there was a decline but considerable increase was seen from 1974 to 1977; in 1978 again there was a decline to the tune at 86% with only 18.6% decrease in the effort when compared to 1977. There are two peaks in the seasonal abundance, one in April–May and the other in August–September. About 17 species contribute to the fishery with *Johnius carutta, J. dussumieri, J. vogleri, Pennahia macrophthalmus, Atrobucca nibe* and *Otolithus ruber* dominant.

Ribbon fish

An estimated annual average catch of 536 tonnes were obtained by the trawlers during the ten-year period. Starting from 1969, the catches showed gradual increase in the next two years but in 1972 there was decline. The catches however increased in 1973 and this increasing trend continued till 1977 but in 1978 there was a decline. Though ribbon fish is a pelagic resource, they are caught in considerable quantities by the trawlers when these fishes move into the trawling ground in large shoals. The data show that these fishes are abundant on the fishing ground during April–June. About 6 species occur in the catches but

Table 2. *Estimated catches (kg) of different groups/species by three types of boats combined during different years.*

Sl. No.	Name of fish	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	Average for 1969–'78	Percentage	Rank
1.	Prawns	2,68,847	4,02,762	6,02,524	8,65,835	8,21,883	14,31,896	16,25,225	24,28,381	61,91,004	20,25,855	16,66,421	24.90	1
2.	Crabs	26,323	7,827	23,405	63,474	33,989	69,317	1,40,292	1,14,004	2,01,100	37,534	71,727	1.07	22
3.	Cephalopods	15,705	19,056	29,068	44,265	42,877	50,959	89,279	1,05,634	2,56,783	1,30,916	78,454	1.17	19
4.	Sharks	500	2,188	1,364	3,748	4,493	27,555	39,328	1,15,695	34,060	1,98,908	42,784	0.64	28
5.	Rays	60,398	1,13,482	1,29,171	64,834	76,044	1,15,075	2,52,079	1,97,484	1,45,528	39,079	1,19,317	1,78	14
6.	Skates	20,907	26,832	25,063	46,187	15,805	18,063	44,504	11,890	1,74,921	1,92,647	57,682	0.86	23
7.	Eels	24,945	29,890	22,245	43,005	64,200	1,28,647	1,78,448	2,51,403	2,45,898	1,33,825	1,12,251	1.68	16
8.	Cat fish	32,612	30,185	27,841	74,540	66,186	1,40,611	1,64,764	2,91,417	6,59,070	1,22,623	1,60,985	2.41	11
9.	Lesser sardines	9,036	1,989	1,824	6,438	36,905	5,608	37,236	2,76,558	54,895	22,081	45,257	0.68	27
10.	White bait	15,022	10,044	25,157	61,880	45,787	70,793	45,386	2,38,706	4,66,332	2,30,584	1,20,969	1.81	13
11.	*Ophisthopterus*	23,625	24,880	23,670	8,431	9,930	42,680	58,287	39,214	2,60,417	63,316	55,445	0.83	24
12.	*Thryssa* spp	992	16,978	19,706	53,598	46,946	84,539	1,00,396	1,53,823	1,14,140	1,42,375	73,349	1.10	20
13.	Other clupeids	19,456	5,628	14,979	28,056	51,508	34,256	1,04,279	1,68,424	1,34,793	1,77,678	73,906	1.10	21
14.	Bombay duck	264	7,865	22,277	59,583	88,711	95,862	1,16,578	2,03,910	3,38,996	8,64,872	1,79,892	2.69	9
15.	Lizard fish	16,364	36,710	63,543	83,677	23,889	1,77,253	2,00,791	4,07,162	7,11,457	4,19,814	2,14,066	3.20	8
16.	Perches	16,739	15,362	29,482	26,219	27,300	62,388	1,29,245	89,002	3,66,155	1,07,670	86,956	1.30	18
17.	*Nemipterus* spp	1,63,665	1,28,535	1,01,329	1,12,739	2,07,154	2,91,411	4,92,932	5,27,767	13,36,945	3,93,341	3,75,582	5.61	6
18.	Goat fish	8,937	17,571	88,983	1,49,118	64,014	2,15,457	2,41,444	1,46,257	2,05,021	1,17,179	1,25,398	1.87	12
19.	*Polynemus* spp	25,003	20,326	33,127	22,343	23,948	61,331	81,549	23,311	1,80,900	53,845	52,568	0.78	25
20.	Sciaenids	1,98,833	1,75,444	3,34,372	4,42,077	3,43,202	7,63,278	7,96,500	8,73,076	28,38,254	3,97,309	7,16,235	10.70	2
21.	Ribbonfish	54,458	59,391	2,36,230	1,16,391	2,17,514	3,71,559	3,77,254	6,32,449	22,23,435	10,71,212	5,35,989	8.01	3
22.	*Decapterus* spp	26,726	2,553	1,640	12,441	3,18,326	2,352	95,822	13,71,888	19,83,532	99,361	3,91,464	5.85	5
23.	Other carangids	19,508	35,373	28,426	32,525	13,274	53,989	40,574	30,900	70,177	74,780	39,953	0.60	29
24.	Silver belly	60,555	1,12,426	2,81,807	1,93,775	1,62,862	2,29,329	3,39,729	3,23,475	28,88,942	3,97,141	4,99,004	7.48	4
25.	*Lactarius*	59,838	40,267	45,691	48,259	20,103	1,18,367	1,23,662	80,973	5,42,403	70,520	1,15,008	1.72	15
26.	Pomfrets	2,342	1,973	10,922	6,019	7,271	15,757	16,804	31,521	27,370	20,245	14,022	0.20	31
27.	Mackerel	45,793	322	72	15,657	6,974	3,068	490	—	8,048	4,879	8,530	0.13	33
28.	*Sphyraena* spp	1,620	2,245	—	7,126	15,178	4,309	3,224	24,597	38,078	18,594	11,497	0.17	32
29.	*Psettodes erumei*	—	—	1,172	8,615	7,931	11,058	12,829	21,242	41,375	55,060	15,928	0.24	30
30.	Other flat fish	29,946	39,914	35,772	65,065	78,288	1,75,889	2.80,466	2,88,495	5,22,266	1,73,280	1,68,938	2.52	10
31.	*Kurtus indicus*	7,633	16,400	14,492	35,458	12,027	64,822	50,664	1,68,801	74,634	41,604	48,654	0.73	26
32.	*Psenes* spp	14,317	23,841	28	—	4,98,140	29,254	34,470	13,03,983	9,45,421	3,55,274	3,20,473	4.79	7
33.	Miscellaneous	29,330	28,081	33,295	68,081	44,604	62,138	84,618	1,14,805	2,89,591	1,69,512	92.406	1.38	17
	TOTAL	13,00,239	14,56,340	23,08,677	28,69,459	34,97,263	50,28,870	63,99,148	1,10,56,247	2,45,71,941	84,22,913	66,91,110		
	Effort (hours)	34,236	38,201	55,855	67,507	1,34,119	1,77,347	1,87,065	2,37,339	4,14,697	3,76,972	1,72,333		
	Catch/hour	37.9	38.1	41.3	42.5	26.1	28.4	34.2	46.6	59.3	22.3	38.8		

Table 3. *Quarterly estimated total catches (kg) and catch rates (CPH) in parentheses by three different types of boats during 1969–1978.*

	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1969–1978
PABLO											
Ist quarter	1,44,891 (42.21)	1,19,382 (26.60)	2,71,754 (33.35)	4,61,070 (50.46)	4,94,510 (50.36)	3,17,373 (16.09)	2,04,460 (26.21)	6,40,769 (51.33)	8,42,083 (52.41)	1,92,146 (13.78)	36,88,456 (35.14)
IInd quarter	1,65,015 (28.81)	2,58,044 (31.50)	3,39,518 (45.26)	4,00,047 (38.43)	2,01,005 (15.10)	3,21,940 (23.74)	3,73,340 (28.67)	2,31,246 (26.54)	7,81,614 (46.0)	1,62,422 (13.31)	32,34,191 (29.50)
IIIrd quarter	1,85,348 (27.84)	1,80,372 (26.0)	3,79,977 (36.63)	2,61,268 (32.14)	1,51,149 (8.99)	2,84,951 (25.19)	3,11,230 (25.94)	2,78,702 (24.32)	4,93,152 (42.37)	5,20,833 (47.36)	30,46,981 (28.66)
IVth quarter	89,920 (21.76)	1,66,014 (37.0)	3,45,452 (29.94)	1,83,855 (25.01)	1,04,094 (12.07)	1,92,792 (25.05)	1,75,560 (19.84)	1,50,922 (25.33)	2,73,748 (28.46)	1,41,139 (21.02)	18,23,496 (24.33)
POMFRET & ROYYA											
Ist quarter	2,38,043 (67.32)	1,60,448 (53.0)	61,906 (35.09)	1,94,922 (61.76)	5,84,704 (59'09)	6,81,534 (24.42)	7,68,598 (43.61)	38,23,713 (78.96)	73,18,750 (91.75)	24,13,210 (21.28)	1,62,45,828 (52.87)
IInd quarter	1,84,280 (44.35)	1,26,651 (56.5)	1,27,160 (52.82)	2,21,253 (52.31)	2,65,279 (22.64)	4,40,680 (29.13)	7,21,690 (34.19)	14,40,300 (35.49)	55,37,692 (60.12)	10,31,122 (11.25)	1,00,96,107 (35.38)
IIIrd quarter	81,757 (39.04)	57,188 (31.2)	1,67,007 (53.4)	2,36,132 (40.06)	1,95,431 (15.50)	4,63,811 (31.31)	11,10,380 (38.04)	15,31,484 (33.73)	26,25,037 (44.62)	20,61,974 (43.72)	85,30,201 (31.61)
IVth quarter	48,334 (45.9)	72,489 (42.8)	2,01,792 (60.93)	1,78,030 (34.74)	2,27,252 (17.09)	5,56,016 (34.46)	7,32,151 (26.50)	7,46,255 (33.88)	23,95,173 (37.30)	7,01,325 (23.69)	58,58,817 (31.83)
SORRAH											
Ist quarter	39,459 (56.61)	1,21,063 (79.1)	42,936 (44.17)	1,94,535 (64.68)	5,67,706 (84.73)	5,07,934 (29.14)	5,98,162 (51.28)	12,94,008 (90.1)	17,59,634 (91.39)	4,25,997 (23.23)	55,51,434 (59.09)
IInd quarter	19,273 (40.07)	88,638 (61.60)	1,06,451 (56.59)	2,27,802 (60.74)	2,61,471 (26.83)	4,55,020 (37.09)	4,45,744 (37.10)	3,50,162 (34.44)	15,16,234 (73.35)	1,93,271 (12.06)	36,64,066 (41.42)
IIIrd quarter	63,671 (49.05)	58,665 (45.0)	1,06,276 (47.52)	1,79,195 (43.02)	2,08,496 (19.10)	4,81,373 (37.97)	6,61,960 (43.78)	3,87,650 (32,35)	6,22,496 (48.66)	4,30,396 (40.57)	32,00,178 (38.51)
IVth quarter	40,248 (38.22)	47,386 (45.80)	1,58,448 (61.13)	1,31,350 (41.70)	2,36,166 (22.13)	3,25,446 (32.81)	2,95,873 (26.74)	1,81,036 (31.43)	4,06,328 (31.86)	1,49,060 (23.66)	19,71,341 (30.66)

Table 4. *Seasonal variations in the catches of important groups (Average for the period 1969–78)*
(Values in parentheses are percentages)

Name of fish	Jan–Mar Ist Quarter	April–June II Quarter	July–Sep III Quarter	Oct–Dec IV Quarter	Average totals for 10 years.
Prawns	4,33,121 (26.0)	4,58,593 (27.5)	4,73,104 (28.4)	3,01,603 (18.1)	16,66,421
Sciaenids	1,36,895 (19.1)	3,36,524 (47.0)	1,42,707 (19.9)	1,00,108 (14.0)	7,16,234
Ribbonfish	1,27,276 (23.7)	1,70,011 (31.7)	1,54,839 (28.9)	83,863 (15.7)	5,35,989
Silverbelly	2,36,190 (47.3)	1,23,566 (24.8)	80,298 (16.1)	58,950 (11.8)	4,99,004
Decapterus sp	3,87,078 (98.8)	2,969 (0.8)	799 (0.2)	817 (0.2)	3,91,464
Nemipterus spp	2,13,530 (56.8)	60,316 (16.1)	35,274 (9.4)	66,462 (17.7)	3,75,582
Psenes sp	2,89,981 (90.5)	27,902 (8.7)	1,087 (0.3)	1,503 (0.5)	3,20,473
Lizard fish	92,583 (43.2)	45,173 (21.1)	31,956 (14.9)	44,354 (20.7)	2,14,066
Bombay duck	9,690 (5.4)	15,382 (8.6)	1,46,658 (81.5)	8,161 (4.5)	1,79,891
Flat fish	65,104 (38.5)	38,032 (22.5)	34,852 (20.6)	30,950 (18.4)	1,68,938

Trichiurus leptures is the most dominant, contributing about 70% of ribbon fish catches.

Silverbellys

An average of about 500 tonnes are landed annually forming about 7.5% of total landings. The catches of these fishes also showed decline during 1977 and 1978. Although contributing to the fishery throughout the year, they are most abundant during January–March period. Out of 10 species, *Leiognathus bindus* and *Secutor insidiator* are most abundant.

Decapterus sp.

These fishes form a seasonal fishery, most abundant during January–March. Like ribbon fish, this species also is pelagic and caught by trawls when large shoals move into the fishing ground. There are wide fluctuations, like many other pelagic resources, in the catches during different years (Table 5). An average of 391 tonnes are landed annually forming about 6% of trawl catches.

Nemipterus spp.

The ten year average estimated catches show that about 375 tonnes of these fishes are landed annually forming 5.6% of trawl catches. The data on seasonal abundance show that January–March and October–December are the peak periods for these fishes, the first quarter, however, being more productive. Five species occur in the catches, *N. japonicus* being the most dominant.

Penses sp.

This species occurs seasonally and about 90% of the annual catch comes during January–March period. There are wide fluctuations in the catches in different years (Table 5). An average of 320 tonnes are landed annually forming 4.8% of the catches.

Lizard fish

The annual estimated catches range from a minimum of 16 tonnes in 1969 to a maximum of 711 tonnes in

1977. From 1969 the catches showed increase till 1972 but in 1973 there was a deep decline. There was improvement from 1974 till 1977, again declining in 1978. These fishes occur in large quantities during January–March period. About 3 species occur, of which *Saurida tumbil* is the most dominant.

Bombay Duck

Harpodon nehereus occurs seasonally in large quantities. The ten-year data show that this species is abundant during July–September period. The catches showed increasing trend in successive years. Starting with less than 1 tonne in 1969, an estimated 865 tonnes were landed in 1978, the ten year average being 180 tonnes forming 2.7% of the trawl catches.

Flat fish

The estimated annual average catch of these fishes is 185 tonnes forming about 3% of total catches. *Psettodes erumei* and *Cynoglossus* spp are the important species. These fishes occur almost round the year but they are most abundant during January–March period.

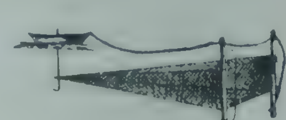
Remarks

In general there was deep decline in the catch per unit effort during 1973 and 1978 for the total trawl catches (Table 2). It is however, observed that the catches showed steady increase from 1969 to 1977 without decline in 1973 and declined only in 1978. So the decline in catch rate in 1973 appears to be brought about by the heavy input of effort, almost double that of the previous year. But in 1978 there is decline in total catch, effort and catch rate.

As already pointed out by Silas *et al., (Bull. Cent. mar. Fish. Res. Inst.*, 27, 1976) and Sudhakara Rao *et al (Mar. Fish. Infor. Serv. T & E Ser.*, 21, 1980), trawling is almost exclusively carried out for prawns because of the export market. This has resulted in extensive coverage of certain parts of the fishing grounds and little or no coverage of other parts, thus affecting the production of other demersal resources. In this connection it may be pointed out that Sriramachandra Murty (Ms: A study of the Sciaenid fisheries off Kakinada along the east coast of India) observed that increase in effort in different years did not bring increased sciaenid catches. Further it has also been shown that in some years, periods of peak effort coincided with periods of poor catches of sciaenid fishes. This increased effort was apparently used to catch prawns in certain parts of the fishing ground. In fact the demand for prawns has also lead to the reduction of the cod end mesh size of the trawl nets (Sudhakara Rao *et al., Mar. Fish. Infor. Serv. T & E Ser.*, 21, 1980) in recent years. Though this has resulted in the increase of the small-sized non-penaeid prawn catch, there is no recognisable change in the length composition of the important groups of finfish caught. This again, is probably, due to the uneven distribution of effort on the fishing ground with the sole aim of catching more prawns. It may be pointed out here that majority of the boats conduct trawling in the inshore waters of 5–20 m depth zone where it is known that the prawns are abundant. If the effort is uniformly distributed on the fishing grounds one would expect large quantities of early juveniles of fish also to be caught at least during certain seasons, on account of reduction in the cod end mesh size.

The boats carry ice in boxes to bring prawns but no such arrangement exists for bringing fin fishes though they constitute about 70% of the catches. This is because the deck-space is not sufficient to keep more boxes with ice and also there is lesser demand for them as compared to prawns. A consequence of this is that in majority of the cases, most of the fishes are spoiled by the time they are landed and hence are not fit for consumption in fresh condition. These fishes are sold at very cheap prices for purposes of salt-curing and sun-drying.

Since the boats are small (Table 1) and have to return to the base every day, the scope for further expansion of the fishing ground is limited. In the light of these observations it is felt that uniform distribution of effort on the existing fishing ground would help increase production of important fin fishes. This, however has to be done keeping the prawn production in view. Another approach would be to introduce larger vessels that can venture into deeper areas which are not covered so far. In any case constant monitoring of the resources would be essential in order to enable appraisal of the fisheries with proper management approach.



A LOW COST ELECTRICAL RUDDER INDICATOR FOR THE MEDIUM SIZED POWER VESSEL*

It is an electrical instrument to indicate the rudder angle of the vessel in degrees with respect to the bow of the vessel in the wheel house. This helps the man at the wheel in manoeuvring the vessel while sailing in general and particularly in the following occasions:

1. When the vessel is started at open sea after it was stopped for some time, the Rudder indicator helps the operator to know the set position of the rudder, enabling him to reset for the new course without delay. Otherwise the operator has to turn the steering wheel to the maximum of either port or starboard and then turn to the required direction.

2. While sailing on a straight course, the forces of wind and current and their effects on rudder can be noticed with the aid of the Rudder indicator.

3. At times the steering wheel may rotate, but the rudder may not move because of the failure of the coupling system. The Rudder indicator can confirm this situation indicating whether the rudder is moving or not while turning the wheel.

4. If any slack exist in the wire rope, connecting the steering wheel and the quadrant, this can be noticed through Rudder indicator.

5. While encircling a fish school using purse seine, the Rudder indicator helps in making big or small circle as required depending upon the school size.

Considering the utility of the instrument and non-availability of a commercial model in the local market, it was decided to design and fabricate one proto-type of the instrument for Cadalmin IX, a 43′ vessel of the Institute. Accordingly the instrument has been fabricated and tested on board the vessel and found successful. It consists of a rudder angle sensor mounted on the quadrant and a display panel in the wheel house with the appropriate electrical connections. The details of the instrument are described below with circuit diagram.

Principle of operation and design considerations

The mechanical movement of the rudder is converted into an electrical signal using a centre tapped potentiometer and fed to an indicator whose pointer movement is synchronised with the movement of rudder with 180° out of phase. The rudder is mechanically coupled to the steering wheel of the vessel which controls the rudder movement through the quadrant. The coupling arrangement is such that when the wheel is turned to the port side in order to turn the vessel to port, the rudder will move towards starboard side. The pointer of the indicator will deflect to the port indicating the direction of the turning of the vessel and vice-versa. The shaft of the angle sensor (potentiometer) is coupled to the quadrant of the vesse mechanically. The body of the pot meter is held by a metal frame fixed to the sides of the hatch. Hence the wiper of the pot meter is free to move when the shaft of the quadrant move. A DC supply of equal and opposite polarity is applied to the end of the pot meter and the common point of the supply source is connected to the centre tap of the pot meter. The centre zero D.C. Volt meter is connected across the centre tap and the wiper of the pot meter. When the steering wheel is rotated the quadrant moves as it is coupled mechanically through wire rope. Simultaneously the wiper of the pot meter moves as it is directly coupled with the quadrant. As the wiper moves the voltage given to the voltmeter is varied linearly. When the vessel is in midship, the position of the wiper is adjusted so as to be at zero volt. When the quadrant moves starboard side the wiper moves along +ve supply and when the quadrant moves port side the wiper travels along –ve supply. Accordingly the pointer of the voltmeter also moves along the starboard and port side respectively from the centre. The movement of the pointer has been calibrated in terms of angles in degrees. The maximum

*Prepared by S. Natarajan

voltage permissible to be applied to the meter is equal to the full scale deflection voltage (FSD) of the meter. Hence the applied voltage to the circuits need be exactly equivalent to the FSD voltage or else the supply can be greater than the FSD voltage but it must be controlled to be equivalent to the FSD voltage, across the meter. Therefore a supply controlling circuit

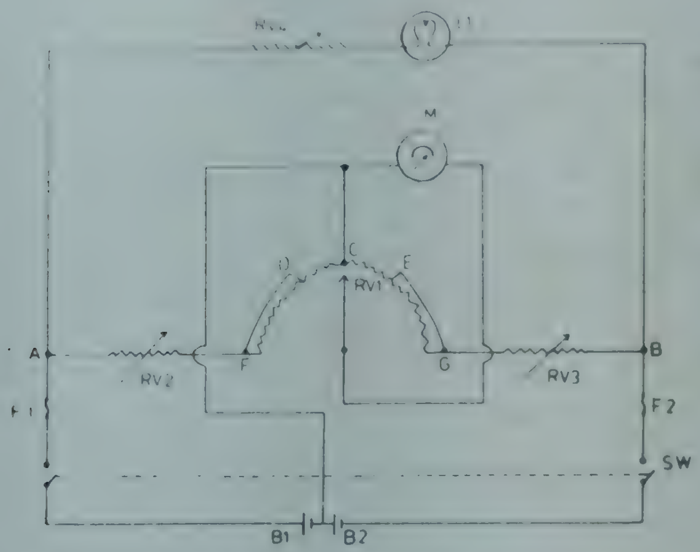


Fig. 1. Circuit diagram of electric rudder indicator

is also required to be incorporated. If the applied voltage is +12 V and the FSD is 3 V, two linear pot meters can be connected in series to the angle sensor, one at each end and the resistance can be adjusted so as to get exactly +3 V when the quadrant is fully starboard side and –3 V when the quadrant is moved fully to the port side. The value of the resistance need be so chosen considering the half section value of the resistance of the angle sensor and the voltage to be dropped across the series resistance, with the tolerance to adjust for the input supply variation. Therefore the minimum power supply required to operate the instrument is twice the FSD voltage plus the expected variation in the input supply source.

Circuit construction

RV_1 (fig. 1) is the wirewound variable resistance (potentiometer) of 1K ohm 7 watts with a centre tap, functioning as angle sensor. The ends of the sensor are connected to the opposite terminals of two 12 V batteries (Bl, B2) in series through the variable resistance RV_2, RV_3 of 1K each, dial lamp, fuse Fl, F2 and a double pole single throw switch. The DC voltmeter M of 3 V FSD with centre zero (3-0-3V) is connected across the centre tap of the sensor (RV_1) and its wiper. Also the centre tap is connected to common point of the 2 batteries. Ll is the dial lamp (24 V miniature type), connected across the supply through RV_4 (5K variable resistance).

Circuit explanation

When the switch is put on, it connects the 24 V supply to the circuits. The dial lamp Ll glows. The brightness of the light is controlled by the potmeter RV_4 (dimmer control). 24V is applied across RV_2, RV_1 and RV_3 in series. Voltage between centre tap of RV_1 and the +ve terminal of the battery is +12 V and the centre tap of RV_1 and –ve terminal of the source is –ve 12 V. The movement of the wiper is restricted to 40° either side from centre, C to D and C to E because this is the limit to which the quadrant of the vessel can travel. Hence the rest of the portion of the variable resistance is shorted out in either side (DF and EG). Keeping the wiper at the centre C, the RV_2 and RV_3 is adjusted to have +3 V between CD and –3V between CE. Now when the wiper is at the centre the meter reads zero. When it moves towards D the meter deflects to the star board side from the centre. When the wiper is moved towards 'E' the pointer deflects towards port side.

The meter has been fixed with a calibrated dial to read the position of the quadrant in degrees upto the maximum of 40° in both port and star board sides. Port and starboard side of the dial has been painted with red and green respectively.

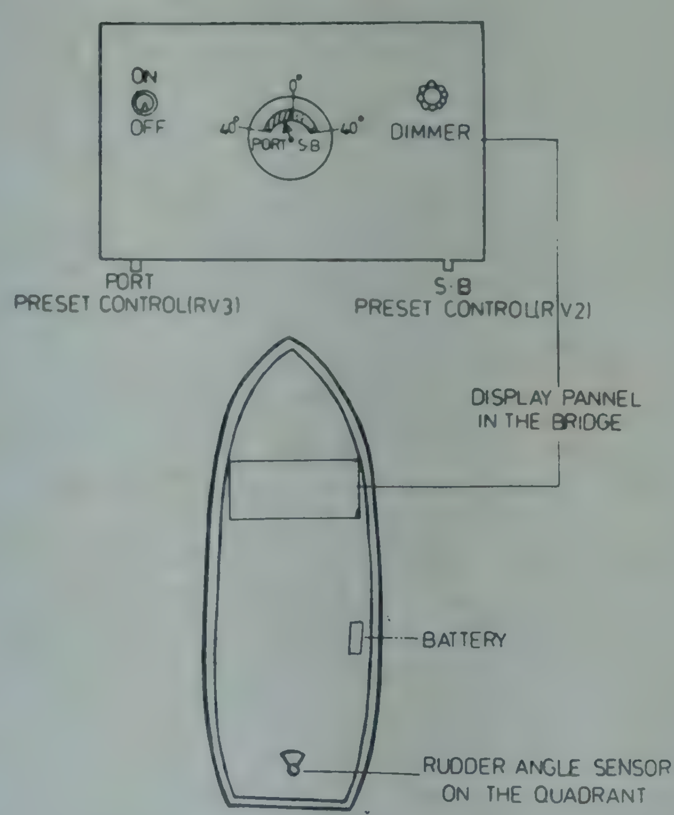


Fig. 2. Location diagram of rudder indicator on board Cadalmin IX

Installation, test and calibration

The electrical components RV_2, RV_3 and RV_4 along with the indicator meter are mounted in a perspex box (8″ x 5″ x 2″) and fixed in the wheel house of the boat (Fig. 2 and 3). RV_1 is in a 2″ x 2″ x 2″ metal box filled with greese and fixed at the quadrant (Fig. 4). 10 amp 4 core cable connects the 24 V supply from the main box to RV_1 pot meter (the sensor), and brings the signal to the indicator. The common point

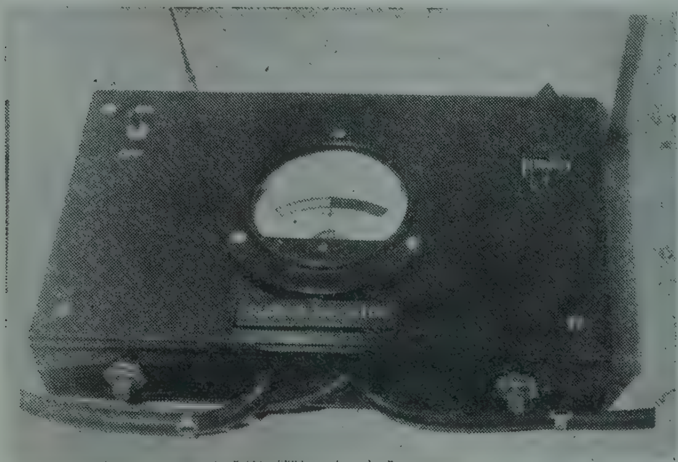


Fig. 3. Display unit

of the battery is connected to the centre tap of the sensor (RV_1) by a single core wire. Battery supply is connected from the wheel house to the main box through the switch. Equipment was installed in the vessel Cadalmin IX on 7–4–81 and was calibrated by adjusting RV_2 and RV_3 to read 40° either side while rotating the steering wheel to the maximum of starboard and port side respectively. Performance test was carried out by sailing the vessel in the open sea and found functioning satisfactorily.

As the vessel Cadalmin IX was equipped with 24 V battery (2 batteries of 12 V each) the rudder indicator was designed to work on 24 Volt. Same system can work with 9 Volts also (6 number dry cells of 1.5 v each), by resetting the present control RV_2 and RV_3. This has been confirmed by testing at the laboratory.

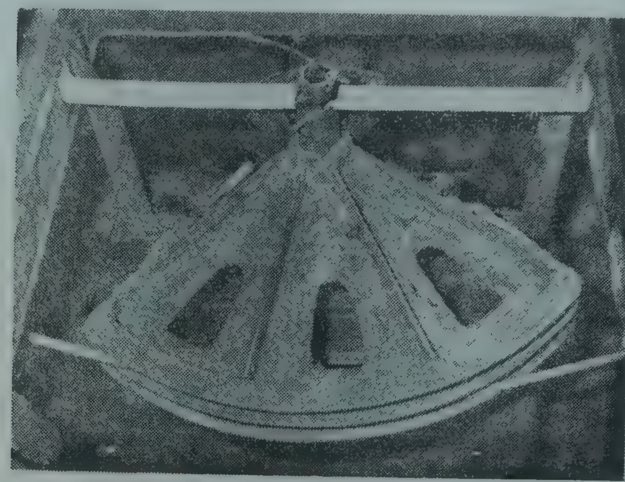


Fig. 4. Angle sensor at the quadrant of the vessel

Therefore if this instrument is required to be installed on board a vessel where 24 V battery provision is not there, it can be operated with 6 number dry cells of 1.5 V each,ie. 9 volt supply with the centre tap. All the required parts for the instrument are available locally. The approximate cost of the materials including the cable is Rs. 350/- only.

Routine check and maintenance

Before sailing the vessel, the display should be checked by rotating the steering wheel to the maximum of port and starboard sides to confirm the pointer moves to 40° in both side correspondingly. If not, the preset control RV_2 and RV_3 are to be adjusted so as to have 40° reading. The position of the rudder angle sensor is required to be checked once in a week to confirm that it is held properly. It is preferred to have general external cleaning daily on and around the angle sensor.

BARRACUDAS*

The barracudas, otherwise known as sea-pikes of the family Sphyraenidae, are caught in sizeable quantities along the Indian coast. They are reported to occur in all tropical waters. Of the four distinct species reported from the Indo-Pacific region viz., *Sphyraena barracuda* (Walbaum), *S. jello* Cuvier, *S. forsteri* Cuvier and *S. obtusata* Cuvier (Fig. 1), the former two species attain more than 1.5 m in length whereas others grow to a maximum of 40–60 cm, the common size range being 20–30 cm (Fischer and Whitehead, 1974. *Species identification sheets for fishery purposes IV. F.A.O. Rome).*

*Prepared by K. Mahadevan Pillai

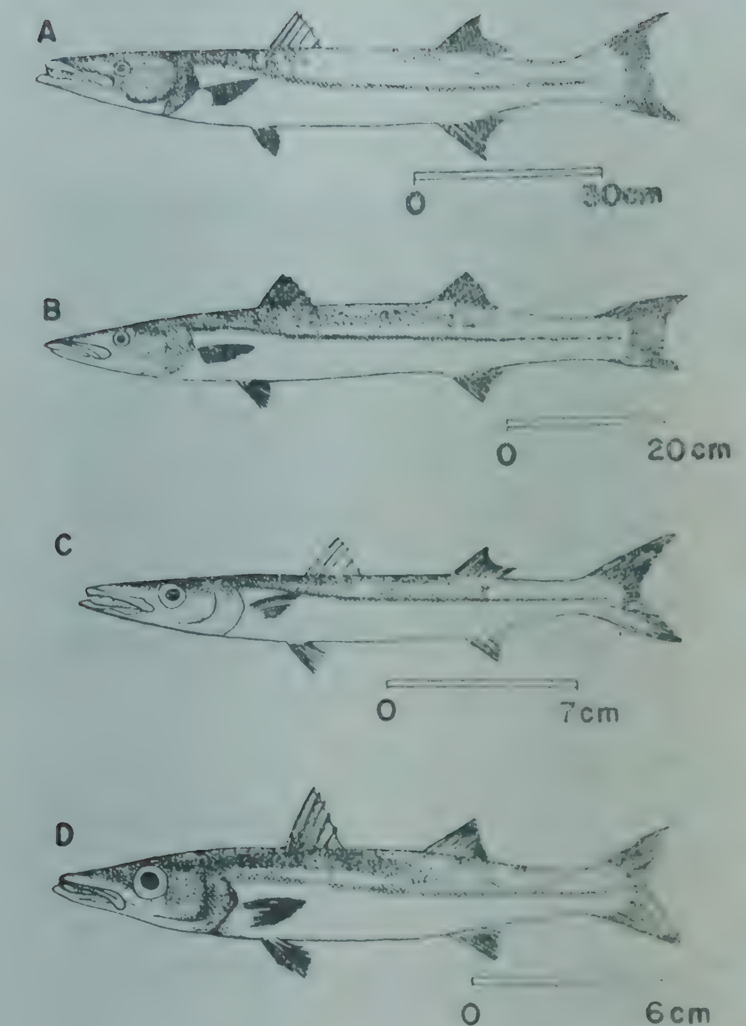


Fig. 1. Common species of barracudas–A. *Sphyraena barracuda* (Walbaum), B. *S. jello* Cuvier, C. *S. forsteri* Cuvier, D. *S. obtusata* Cuvier.

The barracudas possess an elongated and sub cyclindrical body with small cycloid scales. Head is long with a projecting lower jaw and a horizontal cleft of mouth. They draw unusual interest because of their sharp teeth which are large, unequal, fang-like and implanted in sockets in both jaws and palatines. Two widely separated dorsal fins, the first with five strong spines and the second originating opposite to ventral are characteristic of these fishes.

They are pelagic in habitat and are caught at varying depths from the surface down upto 40 m. Though they are shoaling species the large individuals are solitary. Due to the swift swimming efficiency they are highly predatory in nature feeding voraciously on other pelagic fishes. It is said that when a group of barracuda have eaten enough, it herds the rest of the shoal it is attacking into shallow water and keeps guard over it so as to consume them at leisure. Large barracudas are said to be most ferocious among predatory fishes. They are dreaded by fishermen in tropical and subtropical seas due to their alleged attack on human beings.

Ovarian development indicates that barracudas may spawn more than once each season. The number of eggs released increase with age and size, ranging from an estimated 42,000 for a first spawning to over 484,000 for older fish. In four days after hatching, the larvae begin to assume adult morphological characteristics, particularly the lower jaw and are capable of feeding.

The barracudas figured prominently in the development of purse seine fishery and were the object of an International Fisheries Commission study along the Californian waters. In order to manage the barracuda resources, the California Department of Fish and Game has even recommended to initiate action to prohibit the landings of any barracuda under 70 cm in total length in both sport and commercial fisheries.

An estimated 16,662 tonnes of barracudas were landed from the entire Indo-Pacific region during 1972. During the period 1969–'80, the maximum landings of barracudas (4,862 tonnes) from the Indian waters were recorded in 1974 (Fig. 2). Out of an estimated landings of 2,265 tonnes in 1979, Tamilnadu contributed

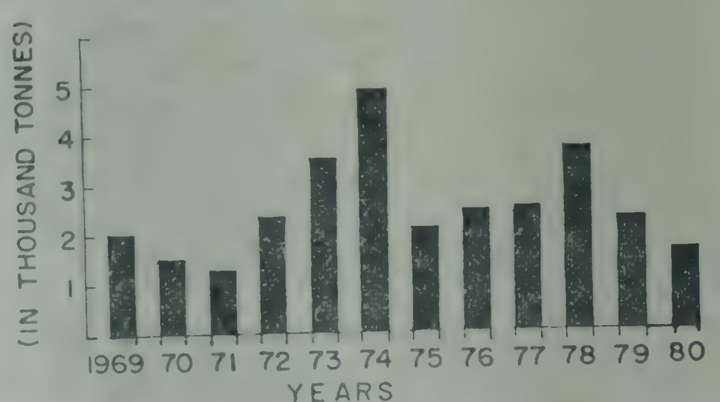


Fig. 2. Annual landings of barracudas in India from 1969 to 1980.

the maximum (1,463 tonnes) followed by Kerala (477 tonnes). Most of the larger species are caught in hooks and lines, bottom-set gill nets and drift gill nets while sizeable quantities of smaller varieties are caught by trawlers from the inshore waters along the Indian coast. The large varieties are in good demand due to their delicate flesh and are marketed in fresh conditions.

CULTURE OF FISHES IN POLYTHENE LINED PONDS*

Experiments have proved that prawns and fishes can be cultured in the unproductive sandy sea shore by lining the ponds suitably with black polythene film. (Lal Mohan and Nandakumaran, 1981 *Mar. Fish. Infor. Ser. T & E Ser.* No. 26). Further experiments indicate the possibility of culturing milk fish and pearl spot in this type of ponds, the results of which are presented here.

Chanos chanos

The milk fish fingerlings of length of 82 mm weighing 3.5 g were stocked on 8–8–1980 in a 0.025 ha pond at the rate of 5600/ha ie,, 140 numbers in the pond. During the first 70 days of stocking the fishes grew about 1 mm/day. The weight increment during the period was 0.42 g/day. Salinity was low during the period ranging between 0.4 to 4.7 ppm. During the next 45 days the fishes registered a growth of 2.1 mm/day and the weight increase was 1.5g/day when the salinity ranged between 1.7–25.7 ppm. The milk fish attained very good growth in this brackish water condition. A growth of 0.7 mm/day and increase in weight of 1.0 g/day was noticed during the ensuing three months when the salinity varied between 29.0–39.4 ppm (Table 1).

The production rate for the first 3 months was 320 kg/ha; at the end of 6 months 880 kg/ha; and when it was harvested after 7 months it was 920 kg/ha. It may be seen that the growth of chanos is faster during the first 6 months (Fig. 1).

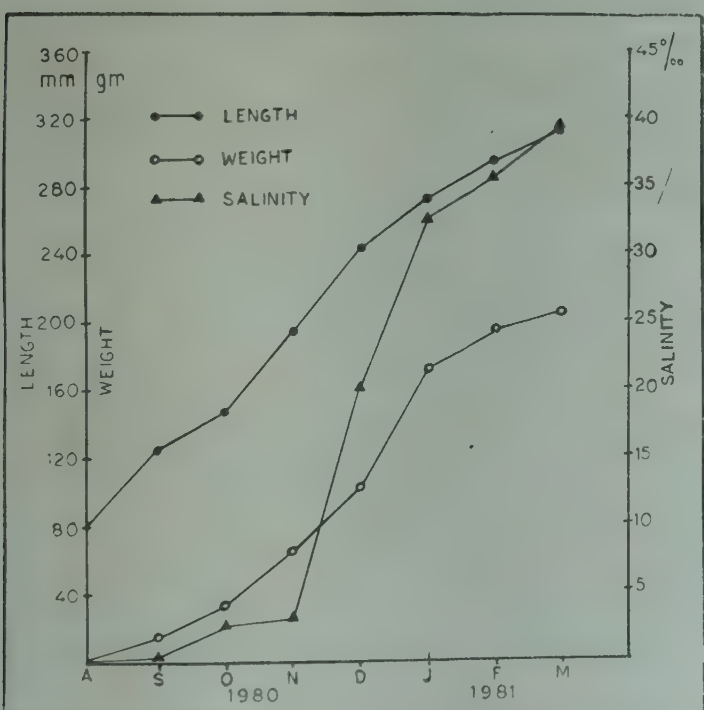


Fig. 1. Growth of Chanos chanos in a polythene lined pond at Calicut.

The fishes were fed with a compounded feed prepared by boiling broken wheat, dry fish and sardine oil mixed at the ratio of 100:10:1. The food was given daily at a rate of 1/10 of the body weight of the stock. The food contained 7.5% protein, 4.8% fat and 77.8% moisture. The fishes were observed to feed on it voraciously. This food, in addition to being cheap and easy to prepare even by the fishermen, does not dissolve and spoil the water.

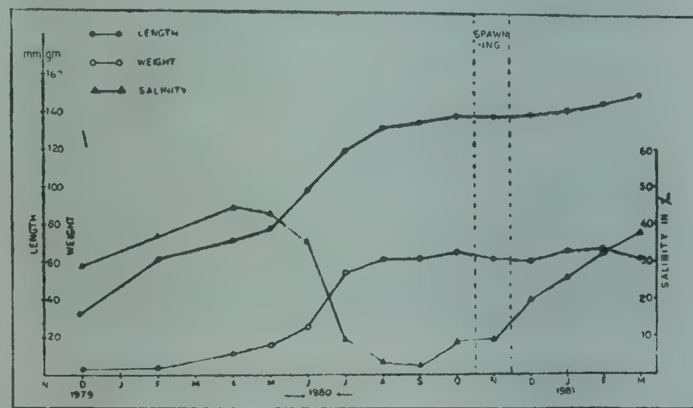


Fig. 2. Growth of *Etroplus suratensis* in a polythene lined pond at Calicut.

The water qualities were tested daily and the temperature inside the ponds varied between 24.5 and 39.0 C. Dissolved oxygen and salinity of the pond ranged between 1.9–6.6 ml/l and 0.4 to 39.4 ppm respectively. The pond had a very good growth of phytoplankton like *Thallasiosira* spp., *Coscinodiscus spp., Merismopedia* spp., *Microcystis* spp. etc.

Final harvest after 7 months was 23 kg of chanos (numbering 120 fish) from a 0.025 ha pond, giving a production rate of 920 kg/ha for 7 months. The survival rate was 86%. The cost economics of the culture experiment is shown in Table 3.

Etroplus suratensis

In December 1979 *Etroplus* (pearl spot) fingerlings measuring 30 mm weighing 1.0 g. was stocked in another pond of area 0.025 ha at the rate of 8400/ha. i.e., 210 numbers in the pond. The water conditions

* By R. S. Lal Mohan and K. Nandakumaran

and feed used were more or less similar to the previous experiment.

The monthly increment of length and weight were slow when compared to the milk fish (Fig. 2.) During the first 6 months the monthly increase of length was 8 mm and the weight increment was 2.3 g. Salinity of the pond was high during the period ranging from 24.9–47.3 ppm. During the next 3 months from June to August the growth was 18 mm/month with an increase in weight of 15.5 g/month, showing a much higher growth rate compared to the previous 6 months (Table 2). Due to monsoon the salinity of the pond got reduced from 47.3 to 3.2 ppm.

Fig. 3. Portion of the harvest of *Chanos chanos* after 7 months from a 0.025 ha polythene lined pond.

Fig. 4. Portion of the harvest of *Etroplus suratensis* after 15 months from a 0.025 ha polythene lined pond.

The growth of the fishes was very slow during the next 7 months which included the breeding season of the fish. The growth was only 2.6 mm/month and the weight increase was only 0.29 g/month (Fig. 2). Salinity during the period ranged from 0.8–38.3 ppm. *Etroplus* was found to breed during November after one year of stocking when salinity rose to 9.9 ppm. However to facilitate spawning, laterite stones and

Table 1. *Observations on the growth of Chanos chanos in a .025 ha polythene lined pond.*

Date (Month)	Length (Mean) mm	Weight (Mean) g	Salinity (Range) ppm	Oxygen (Range) ml/1	Temp. °C (Range) °C
*August (1980)	82	3.5	0.7–1.0	4.3–5.9	27.4 (25.0–32.0)
September	124	16.9	0.4–0.8	4.6–6.6	28.5 (25.0–32.0)
October	148	33.0	2.4–4.7	2.7–5.3	28.5 (24.5–32.0)
November	196	67.0	1.7–5.3	3.2–4.5	29.5 (26.0–39.0)
December	243	103.0	18.6–25.7	1.9–5.2	29.3 (26.0–33.0)
January	277	173.0	29.0–34.4	2.7–4.0	29.5 (25.0–34.0)
February	294	182.0	33.3–39.4	3.9–5.2	29.0 (27.0–34.0)
March	310	202.0	38.4	4.1	29.5 (26.0–34.0)

* Stocking date 8–8–1980; seeds from the low lying area adjacent to the fish farm.

Table 2. *Observations on the growth of Etroplus suratensis in a .025 ha polythene lined pond.*

Date	Length (Mean) mm	Weight (Mean) g	Salinity (Range) ppm	Oxygen (Range) ml/I	Temp. °C (Mean) range °C
December '79	30	1.0	24.9–26.1	1.6–4.3	27.1 (25.0–29.0)
February '80	61	6.1	34.5–34.9	3.5–6.0	29.5 (27.0–32.0)
April	74	11.5	41.0–47.2	3.4–4.3	30.8 (25.0–36.0)
May	78	14.8	33.7–47.3	0.7–3.3	32.0 (29.0–36.0)
June	100	25.5	8.1–37.2	2.2–4.9	28.1 (24.0–34.0)
July	120	57.0	3.8–6.3	2.9–4.9	26.6 (24.0–30.0)
August	132	61.2	3.2–4.6	4.4–6.5	26.9 (25.0–31.0)
September	135	61.2	0.8	5.4–5.5	28.6 (26.0–31.0)
October	138	65.7	6.7–11.4	3.0–6.4	27.6 (25.0–32.0)
November*	138	61.5	7.4–12.3	2.5–6.7	29.6 (25.0–35.0)
December	138	60.8	16.8–22.9	2.3–5.5	29.4 (26.5–33.0)
January '81	141	66.7	26.9–32.1	1.7–3.8	29.0 (27.5–33.0)
February	145	66.4	30.5–36.0	2.6–3.6	29.5 (27.0–33.5)
March	150	62.6	38.3	3.6	30.0 (26.0–35.0)

* Spawning

floating bamboo reapers were provided as substrata for the eggs. There was good growth of filamentous algae in the ponds during October to March.

The production rate was 372 kg/ha for the first 9 months. After this period the growth was very slow and the fishes have grown from 138 to 150 mm and weight increment was almost nil. Hence it is better to harvest *Etroplus* after 8–9 months. If spawners and seeds are required they can be kept longer.

After about 15 months 9.5 kg of *Etroplus* was harvested. The production rate works out to 380 kg/ha, which is much lower than that of *Chanos chanos* obtained in the other experiment. The survival rate at the end of 15 months was found to be 72%,which also is lower than *Chanos*. Economics of operation showing the inputs and yield is shown in Table 3.

From these results it would appear that farming the milkfish is much more economical than that of pearl spot in these polythene-lined ponds. However, more data based on large scale operations is needed from these ponds before the economic viability of the culture system is evaluated.

Table 3. *Economics of fish culture in polythene lined ponds (Pond area .025 ha)*

Expenditure	Rs. Ps.	Income	Rs. Ps.
1. Species: *Chanos chanos*			
i) Cost of polythene film (@ Rs. 3.50/sq.m. for 250 sq.m.) Sheet can be used repeatedly	875.00	Sales of fishes @ Rs. 7.50/kg for 23 kg (920 kg/ha/7 months)	172.50
ii) Cost of digging :	800.00		
Recurring expenses :			
1. Food (23 kgs of broken wheat @ 0.80/kg: Rs. 18.40) 2.3 kgs of dry fish @ 3.50/kg; Rs. 8.05 230 ml of sardine oil @ Rs. 16/kg; Rs. 3.68	30.15		
2. Pumping charges @ Rs. 3.10/hr for 15 hrs	46.50		
Total (Recurring)	76.65 (Rs. 3066/ha)		172.50 (Rs. 6900/ha)
2. Species: *Etroplus suratensis*			
i) Cost of polythene film (Details as above)	875.00	Sales of fishes @ Rs. 10.00/kg for 9.5 kgs. (380 kg/ha/15 months)	95.00
ii) Cost of digging	800.00		
Recurring expenses:			
1. Food 42 kgs of broken wheat @ Rs. 0.80/kg; Rs. 33.60 4.2 kgs of dry fish @ 3.5/kg: Rs. 14.70 400 ml of sardine oil @ Rs. 16/kg: Rs. 6.40	54.70		
2. Water pumping charges @ Rs. 3.10/hr for 15 hrs	31.00		
Total Recurring expenses	85.70 (Rs. 3428/ha)		95.00 (Rs. 3800/ha)

A colour film in English entitled 'Mariculture' is available at a cost of Rs. 3,500/- for 16 mm print and Rs. 6,160/- for 35 mm print. For further details please contact Films Division, Ministry of Information and Broadcasting, Government of India, 24, Dr. G. Deshmukh Marg, Bombay-400 026.

UNUSUALLY HEAVY CATCHES OF RIBBON FISH CLOSE TO THE SHORE AT VISAKHAPATNAM*

Very heavy catches of ribbonfish were observed quite close to the shore at Visakhapatnam for a very short duration. Observations were made on this fishery and certain important biological aspects and the results are presented.

Fishery

A shoal of ribbon fish, *Lepturacanthus savala* (Cuvier) made its appearance on 7–4–81 at the harbour entrance channel, lasted through the next two days moving northwards towards Lawson's Bay and disappeared by 10–4–81 (Table 1).

On 8–4–81, one shore-seine landed a record catch of 5 tonnes, at Lawson's Bay. Most of the nets landed exclusively ribbonfish. Some shore-seines which did not land ribbonfish on that day landed small quantities of miscellaneous fish eg., juveniles of *Leiognathus* sp., *Gazza* sp., *Sillago* sp., *Sardinella gibbosa*, *Stolephorus devisi*, *Rastrelliger kanagurta*, *Sepia* sp., *Loligo* sp., *Selar crumenophthalmus* etc.

The shore-seines operated within 1 km from the shore (Fig. 1) many units performed 3–5 operations. Small trawlers operating 2–4 km from the shore landed *L. savala* together with *Decapterus dayi* and *Psenes indicus*.

By 9–4–81 the intensity of the ribbonfish catch dwindled. Boat-seines did not land ribbonfish at the harbour channel. Shore-seines did not operate due to a local festival. Small trawlers operating 3–5 km off the coast landed 1.5 tonnes of ribbonfish, alongwith *Nemipterus japonicus*, *Decapterus dayi* and *Psenes indicus*. On 10–4–81 ribbonfish were not caught by any of the gears.

* Prepared by K. Radhakrishna, S. Reuben and M. V. Soma Raju

Table 1. *Details of fishery of Lepturacanthus savala*

Date	Area	Gear	No. of units	Effort in man hours	Total estimated catch (tonnes)	Catch of *L. savala* (tonnes)	% of *L. savala*
7–4–81	Harbour Entrance Channel	Boat seine	25	375	15.5	15	98
–do–	Pithapuram Beach	Shore seine	5	150	1 (Lesser sardines and misc.)	0	0
–do–	Lawson's Bay	–do–	12	325	2.5 (Lesser sardines and misc.)	0	0
8–4–81	Harbour Entrance Channel	Boat seine	No operations				
–do–	Pithapuram Beach	Shore seine	1	30	40 kg (misc.)	0	0
–do–	Lawson's Bay	–do–	60	1800	91	90	99
–do–	Off shore (2–3 km)	Mechanised trawlers	33	—	3.6	1.3	35
9–4–81	Harbour Entrance Channel	Boat seine	20	300	2	0	
–do–	Pithapuram Beach	Shore seine	No operations				
–do–	Lawson's Bay	–do–	,,	,,			
–do–	Off shore (4–5 km)	Small trawlers	56	—	11.1	1.9	17

Fig. 1. Shore seines in operation.

Biological observations

The entire catch of ribbonfish was composed of only one species. viz., *Lepturacanthus savala* (Fig. 2). Length measurements of random samples from shore-seine landings of 8–4–81 at Lawson's Bay revealed that the total length ranged from 540 to 750 mm. 67% of the fish ranged from 580–640 mm in total length. The mode was located at 620–629 mm size group. The average weight of the fish was 13.7 g.

Stomach content analysis of the shore-seine sample showed that 18% of the guts were full, 45% were 3/4th full, 23% half full and 14% ¼th full. Empty guts were not encountered in the fish landed by shore-seine, whereas in the boat-seine samples 50% guts were empty and in trawl samples 90% guts were empty.

The food items in the guts were in fairly fresh condition indicating recent feeding. The major food items were *Stolephorus* sp., *Leiognathus* sp., mullets, *Solenocera* sp., and *Acetes* sp. Partly digested fish remains were present in all the guts examined.

Maturity studies indicated that all the fish examined were in spent condition. The ratio between females and males was 81:19 in shore-seine samples, 75:25 in boat-seine samples and 50:50 in trawler samples.

Routine sampling at Lawson's Bay on 14–4–81 showed large quantities of very young *L. savala* measuring 90–170 mm in total length in the shore-seine landings. This would indicate that *L. savala* spawned very recently in the immediate vicinity of Visakhapatnam.

Remarks

Ribbonfish do not generally come very close to the shore. As such they are very rarely caught in the shore-seines. They are normally caught in boat-seines operating 3–4 km away from the shore and in trawl nets.

The unusual appearance of ribbonfish so close to the shore (½ – 1 km from the shore), the spent condition of the gonads, the intensity of feeding and the nature of stomach contents show that the fish have hit the shore in search of food after spawning. The similarity of the stomach contents and the miscellaneous catch of the shore-seine vindicate this view.

The appearance of ribbon fish on 7–4–81 in the boat-seines and again in the shore-seines further north and

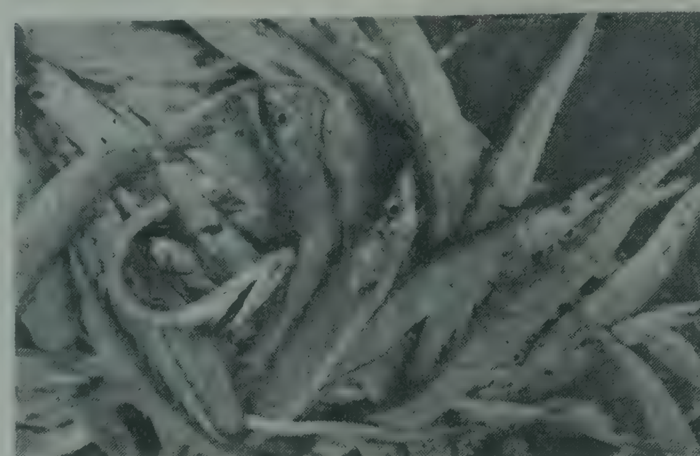


Fig. 2. Ribbon fish, *Lepturacanthus savala* (Cuvier).

closer to the shore on 8–4–81 indicate that the shoal moved northwards and entered the shore-seine grounds in search of prey. The drop in the catch on 9–4–81 and the total disappearance of the fish on 10–4–81 show that most of the shoal was fished and the remaining shoal moved away from the shore after 8–4–81.

The sea surface temperature on 7–4–81 was 21°C, the dissolved oxygen 4.2 ml/l and the phosphate concentration 0.175 µg at/l. These observations i.e., the relatively low temperature and oxygen concentration and high phosphate levels indicate possible upwelling, which is normal in March–April along the northern Andhra coast. The appearance of *Psenes indicus* and *Decapterus dayi* which prefer colder waters in the fishery would also indicate upwelling. It is possible that the ribbon fish shoal after spawning hit the shore chasing their food consisting of *Stolephorus* sp, *Leiognathus* sp. etc. which might have been moving closer to the shore to avoid the cold upwelled water.

Poaching in Indian waters

Illegal fishing by foreign fishing vessels in India's exclusive economic zone is increasingly reported, particularly in the Bay of Bengal. According to informed sources, a conservative estimate would be about 250 "pirate" vessels operating at any given time in the zone and these vessels are actually plundering the marine resources of the country.

The coast guard established to curb the poaching is very poorly equipped for the task. It was established under the Ministry of Defence in August 1978 to protect the Indian EEZ and comprises three regional headquarters in Bombay, Madras and Port Blair in the Andaman Islands. Each regional headquarters has about 500,000 sq. km of sea under its jurisdiction with 2 frigates stationed in Bombay, 2 patrol boats in Madras and 3 in the Andamans. One or two patrol vessels will be joining the fleet shortly, but this is too inadequate. Proposals to equip the guard in the next five years with surveillance aircraft, rescue and pollution control ships and light helicopters have been approved. Letters of intent have been placed for 3 offshore and 3 inshore patrol vessels for delivery starting 1981–82. In addition more sophisticated weapons for the guard are being acquired.

Sonar aid for fishing from China

The development of a multi-beam fish scanning sonar which would greatly facilitate ocean fishing has been announced in Beijing by a spokesman for the Institute of Acoustics under Academy of Sciences, China. It is reported that the sonar developed by the Shanghai Acoustics Laboratory has 12 receiving beams, covering a sector of 90 degrees and it can be rotated a full 360 degrees.

The sonar can detect fish shoals in either shallow or deep waters and it displays the position, distance and range of fish shoals. According to the spokesman the equipment has been in trial use for three years. It is capable of detecting shoals amounting to 10 to 200 tonnes of fish at a distance of 500 m to 2,000 m.

One Shanghai fishing boat equipped with the instrument is stated to have caught more than 1,000 tonnes of fish in the first two months of this year, an increase of 70 per cent as compared with boats fishing without the aid of the equipment. Another sonar-equipped boat is said to have hauled in 21 tonnes of fish in one operation. The equipment would soon be put into serial production.

Alcohol to relieve shocks to squids

Australian scientists at Warrnambool Institute of Advanced Education in Victoria are experimenting with methods to keep squids alive in captivity so that fishermen can keep them alive until they reach the processing plant. This would be of great commercial application as squids lose colour and some of their table quality when dead. One of the methods being tried is to add few drops of alcohol to the seawater holding the squids.

The problem is that the squids are quite excitable and nervous and likely to die of shock. In order to minimise the shock factor, adding one or two per cent of alcohol to the water would be tried. Alcohol has been reported as having a narcotising effect on some squid species—in other words, it puts them to sleep and keep them less susceptible to shock.

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Antibacterial fish feed additive

The Veterinary and Agricultural Division of the Wellcome Foundation Ltd. has introduced an antibacterial feed additive for use with farmed fish, as an extension of the successful Tribrissen range.

The product, known as Tribrissen 40 per cent Powder, is recommended for use as a feed additive in the treatment of diseases caused by sensitive bacteria in fish and is particularly effective in controlling furunculosis (*Aeromonas salmonicida* infection) and bacterial haemorrhagic septicaemia.

As with other Tribrissen formulations, the two active ingredients of the 40 per cent Powder produce a double sequential blockade of bacterial synthesis of folinic acid, giving a level of antibacterial activity many times greater than that obtained from either drug alone. The Powder contains Trimethoprim BP 6.7 per cent W/W and Sulphadiazine BP 33.3 per cent W/W in a Calcium Carbonate carrier and may be incorporated into the feed either at the time of manufacture or mixed with manufactured feed prior to feeding at the rate of 30 mg/kg body weight daily.

World Fishing 29 (11): November 1980

Compiled and prepared by M. J. George, S. K. Dharmaraja & G. Subbaraju.
Published by Dr. M. J. George, Senior Scientist on behalf of the Director, Central Marine Fisheries Research Institute, Cochin-682 018 and printed at PAICO, Cochin-31

MARINE FISHERIES INFORMATION SERVICE

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No. 32
OCTOBER 1981

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Abbreviation – *Mar. Fish. Infor. Serv. T & E Ser., No.* 32: 1981

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6. News—India and Overseas.

Cover photo : Canoe full of oil sardines

TRENDS IN TOTAL MARINE FISH PRODUCTION IN INDIA—1980†

The estimates of total marine fish production in India during 1980 were arrived at 12,49,837 tonnes as compared to 13,88,380 tonnes during 1979, showing a decline of about 10%. Excepting Andhra Pradesh, Gujarat and Andamans, all the maritime states of India recorded lower landings. The statewise total marine fish landings in India during the years 1979 and 1980 are shown in Table 1.

Table 1. *Statewise total marine fish landings in India during the years 1979 and 1980 (in tonnes)*

Sl. No.	State	1980	1979
1.	West Bengal (Contai coast)	6,097	10,744
2.	Orissa	39,375	51,808
3.	Andhra Pradesh	116,013	91,426
4.	Tamil Nadu	217,394	235,008
5.	Pondicherry*	9,390	10,068
6.	Kerala	279,543	330,509
7.	Karnataka	115,322	126,384
8.	Goa**	24,490	25,388
9.	Maharashtra	231,763	293,326
10.	Gujarat	203,494	191,312
11.	Andamans	1,803	1,721
12.	Lakshadweep	2,909	3,846
13.	Private trawlers +	2,244	16,840
		12,49,837	13,88,380

* Excluding Mahe and Yenam which are included in Kerala and Andhra respectively.
**Excluding Daman and Diu which are included in Gujarat.
+ Partial coverage of larger trawlers.

Pelagic and demersal group of fishes

The specieswise composition of total marine fish landings in India is shown in Table 2. The pelagic group of species comprises of *Chirocentrus*, oil sardine, other sardines, *Hilsa ilisha*, other *Hilsa, Stolephorus, Thrissocles*, other clupeids, *Harpodqn nehereus, Hemiramphus & Belone*, flying fish, ribbon fish, carangids, mackerel, seer fish, tunnies, *Sphyraena, Mugil* and *Bregmaceros*. The elasmobranchs, eels, cat fishes, lizard fishes, perches, red mullets, polynemids, sciaenids, silver bellies, *Lactarius*, pomfrets, soles, prawns lobsters and cephalopods form the demersal group. The statewise break-up of pelagic and demersal group of fishes is shown in Table 3 and Fig. 1.

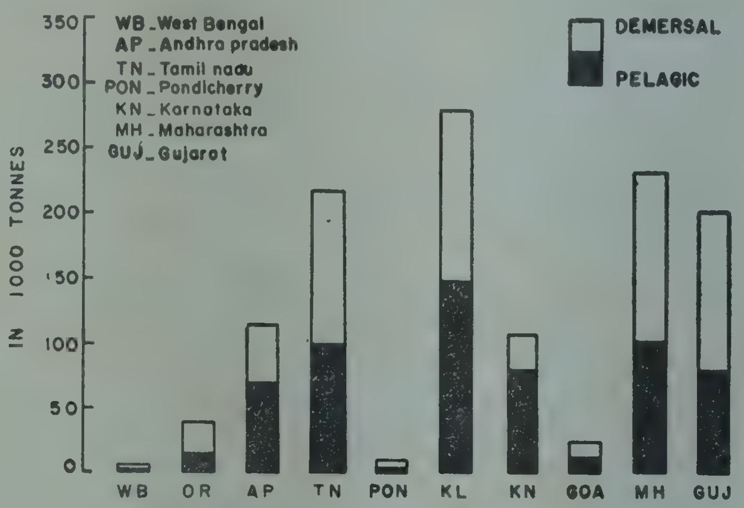

Fig. 1. Distribution pattern of pelagic and demersal group of fishes in different maritime States of India.

From Table 3, it is seen that Kerala accounted for the highest catch of pelagic fishes during 1980, followed by Maharashtra, Tamil Nadu, Karnataka, Gujarat and Andhra Pradesh in the order of abundance. In respect of demersal fishes also Kerala contributed the maximum catch, followed by Maharashtra, Gujarat, Tamil Nadu and Andhra Pradesh.

Statewise marine fish production

West Bengal (Contai coast)

In West Bengal, the total landings declined by about 4,600 tonnes during 1980 as compared to 1979 (Table 1). Lesser landings of other clupeids, Bombay duck, sciaenids and prawns contributed to the decline, the decrease in their landings being about 840, 800, 560 and 270 t. respectively. The landings of catfishes, however, showed an increase of about 580 tonnes.

Orissa

In Orissa also, there was a decline of about 12,400 t. in the total landings during 1980 as compared to 1979.

† Prepared by the Fishery Resources Assessment Division.

Table 2. *Estimated marine fish landings in India during 1980 (in tonnes)*

Sl. No.	Name of fish	West Bengal	Orissa	Andhra Pradesh	Tamil Nadu	Pondi-cherry	Kerala	Karna-taka	Goa	Maha-rashtra	Guja-rat	Anda-mans	Laksha-dweep	Private* Trawlers	Total
1.	Elasmobranchs	114	3,772	4,842	15,442	435	6,803	2,910	894	7,752	14,558	56	284	—	57,862
2.	Eels	—	—	289	85	8	6	131	6	3,154	8,403	—	—	—	12,082
3.	Catfishes	723	2,198	2,338	4,047	78	13,936	5,354	1,151	8,653	5,235	32	—	—	43,745
4.	*Chirocentrus*	276	1,460	1,123	2,695	98	1,002	171	124	2,039	3,792	25	—	—	12,805
5. a)	Oil sardine	—	—	—	320	—	69,667	42,727	2,367	663	—	—	—	—	1,15,744
b)	Lesser sardines	—	1,891	13,930	29,940	2,736	11,017	4,135	1,798	1,363	—	243	—	—	67,053
c)	*Hilsa ilisha*	644	5,091	96	37	25	14	8	8	1,017	56	—	—	—	6,996
d)	Other *Hilsa*	20	46	1,267	3,084	53	21	25	14	607	3,965	25	—	—	9,127
e)	*Anchoviella*	—	270	6,182	13,126	287	7,772	5,621	249	78	—	99	—	—	33,684
f)	*Thrissocles*	194	333	7,326	5,048	387	2,241	850	779	1,271	913	—	—	—	19,342
g)	Other clupeids	674	2,576	5,486	1,833	273	574	1,088	302	16,897	8,538	29	—	—	38,270
6. a)	*Harpodon nehereus*	419	378	611	6	—	—	15	12	57,393	36,671	—	—	—	95,505
b)	*Saurida & Saurus*	—	189	931	1,123	160	7,080	508	199	1,057	85	—	—	—	11,332
7.	*Hemirhamphus & Belone*	—	46	97	749	26	361	180	6	42	6	41	99	—	1,653
8.	Flying fish	—	17	43	1,106	3	—	55	2	—	—	—	29	—	1,255
9.	Perches	13	341	4,639	6,886	666	17,814	1,069	269	3,712	2,454	302	376	—	38,541
10.	Red mullets	—	296	349	1,079	150	1	38	15	461	—	—	27	—	2,416
11.	Polynemids	186	1,126	1,448	629	6	8	—	10	1,976	667	—	—	—	6,056
12.	Sciaenids	358	2,864	9,496	19,547	320	6,164	3,500	1,530	13,956	31,625	—	—	—	89,360
13.	Ribbon fish	142	928	15,646	7,862	179	12,937	1,499	1,089	11,550	10,858	—	—	—	62,690
14. a)	*Caranx*	—	607	5,981	5,405	479	4,399	4,507	884	1,315	461	147	80	—	24,265
b)	*Chorinemus*	130	567	710	1,111	2	145	67	71	357	1,022	—	—	—	4,182
c)	*Trachynotus*	—	—	—	38	2	—	—	—	—	—	—	—	—	40
d)	Other carangids	—	—	97	188	—	59	232	—	369	—	—	—	—	945
e)	*Coryphaena*	—	—	3	141	—	138	—	—	20	—	—	—	—	302
f)	*Elacate*	—	—	19	148	—	19	3	190	—	—	—	—	—	379
15. a)	*Leiognathus*	34	704	3,775	38,153	681	4,147	4,671	1,727	406	—	102	—	—	54,400
b)	*Gazza*	—	3	56	84	—	1	42	—	—	—	—	—	—	186
16.	*Lactarius*	—	65	940	938	29	861	998	614	450	2,520	—	—	—	7,415
17.	Pomfrets	921	9,072	2,201	1,306	188	907	696	257	10,081	12,587	15	—	—	38,231
18.	Mackerel	—	265	6,203	7,229	445	18,474	19,634	2,446	288	112	183	—	—	55,279
19.	Seer fish	234	1,542	2,970	7,179	85	3,763	1,941	735	3,219	4,180	117	21	—	25,986
20.	Tunnies	—	34	419	4,233	—	10,611	952	356	1,674	277	55	1,760	—	20,371
21.	*Sphyraena*	—	8	88	932	55	330	84	171	33	—	67	14	—	1,782
22.	*Mugil*	—	1	27	577	49	151	39	11	24	1,034	117	—	—	2,030
23.	*Bregmaceros*	—	—	—	—	—	—	—	—	159	757	—	—	—	916
24.	Soles	3	69	573	2,094	151	4,394	782	1,311	1,797	2,459	—	—	—	13,633
25. a)	Penaeid prawns	152	1,074	5,660	9,082	485	52,633	3,098	1,853	23,433	14,481	54	—	32	1,12,037
b)	Non-penaeid prawns	48	30	4,346	946	42	1,742	128	—	47,309	4,109	—	—	—	58,700
c)	Lobsters	—	—	10	90	4	18	110	18	225	204	—	—	—	679
d)	Other crustaceans	20	359	1,413	6,174	172	7,286	2,765	1,933	297	4,967	—	—	—	25,386
26.	Cephalopods	4	98	470	1,472	40	4,244	122	210	1,191	3,471	—	13	—	11,335
27.	Miscellaneous	788	1,055	3,913	15,230	591	7,803	4,567	879	5,475	23,027	94	206	2,212	65,840
	TOTAL	6,097	39,375	1,16,013	2,17,394	9,390	2,79,543	1,15,322	24,490	2,31,763	2,03,494	1,803	2,909	2,244	12,49,837

*Partial coverage of larger trawlers

Table 3. *Statewise break-up of the landings of pelagic and demersal group of fishes during 1980 (in tonnes)*

Sl. No.	State	Pelagic	Demersal	Total
1.	West Bengal	3,139	2,958	6,097
2.	Orissa	16,502	22,873	39,375
3.	Andhra Pradesh	70,709	45,304	116,013
4.	Tamil Nadu	99,992	117,402	217,394
5.	Pondicherry	5,532	3,858	9,390
6.	Kerala	147,821	131,722	279,543
7.	Karnataka	87,290	28,032	115,322
8.	Goa	12,046	12,444	24,490
9.	Maharashtra	102,806	128,957	231,763
10.	Gujarat	81,911	121,583	203,494
11.	Andamans	1,211	592	1,803
12.	Lakshadweep	2,156	753	2,909
13.	Private trawlers	—	2,244	2,244
	Total	631,115	618,722	12,49,837

The fall was mainly due to lower landings of *Hilsa ilisha,* sciaenids, prawns, pomfrets, seer fish and elasmobranchs, the decline in their landings being about 4,900, 2,500, 1,900, 1,000, 900 and 600t. respectively. An increase of about 1,100 and 900t. in the landings of other clupeids and cat fishes respectively was also noticed during 1980.

Andhra Pradesh

The estimates of total marine fish production in Andhra Pradesh showed an increase of about 24,600t. (27%) as compared to 1979. An increase in the landings of ribbon fish, lesser sardines, *Thrissocles* and mackerel to the tune of about 9,300, 7,800, 3,900 and 3,600t. respectively was mainly responsible for the higher landings. A decline in the catch of penaeid prawns, seer fish and elasmobranchs to the extent of 3,000, 2,600 and 2,200t. however, was noted.

Tamil Nadu

In Tamil Nadu, the total landings showed a decline of about 17,600t (7.5%). This decrease was due to reduced landings of ribbon fish, *Leiognathus,* lesser sardines and penaeid prawns, the decline being 13,200, 4,700, 3,300 and 1,100 respectively. The landings of mackerel, *Anchoviella* and sciaenids, however, showed an increase of about 3,700, 2,100 and 600t. respectively.

Pondicherry

The total catch in Pondicherry recorded a decrease of about 700t. (6.7%). Flying fish and perches showed a decline of about 850 and 340t. respectively in their catch. The landings of lesser sardines, however, showed an increase of about 740t.

Kerala

In Kerala, the total landings decreased by about 51,000t. (15.4%). The decline was mainly due to reduced landings of oil sardine, ribbon fish, *Caranx,* lesser sardines, tunnies, seer fish and perches, the decrease in their landings being 47,200, 12,800, 7,900, 4,900, 4,800, 2,500 and 2,400t. respectively. Penaeid prawns, cat fishes and non-penaeid prawns, however, showed an increase of about 23,100, 2,600 and 1,700t. respectively in their landings.

A scrutiny of the catch of oil sardine showed that there was a substantial fall in the Alleppey–Ponnani and Quilandy–Manjeswar coastal belts. The significant increase of about 23,100t. in the landings of penaeid prawns was mainly due to higher catches by mechanised fishing crafts in the Sakthikulangara area.

Karnataka

The total landings in Karnataka declined by about 11,100t. (8.8%) as compared to 1979. This was mainly due to decreased landings of mackerel, cat fishes and penaeid prawns, the decline in their landings being about 20,500, 4,600 and 1,600t. respectively. Oil sardine, *Anchoviella* and *Leiognathus,* however, showed an increase to the tune of about 9,600, 3,900 and 3,100t. respectively in their catch.

Goa

In Goa, the total catch showed a marginal decrease of about 900t. (3.5%). While the landings of mackerel and oil sardine showed a decline of about 1,900 and 700t. respectively, *Leiognathus* catch showed an increase of about 800t.

Maharashtra

The total estimates of marine fish production during 1980 were 231,763t. The broad indications are that the landings of penaeid prawns, non-penaeid prawns and *Harpodon nehereus* showed a decline of about 22,000; 9,000 and 2,000t. respectively.

Gujarat

An increase of about 12,200t. (6.4%) in the total landings was noticed in Gujarat over that of 1979. The landings of elasmobranchs, ribbon fish, penaeid prawns, eels, sciaenids and pomfrets showed an increase of about 9,600, 6,400, 5,900, 5,800, 3,400 and 3,300t. respectively. *Harpodon nehereus*, however, showed a decline of about 27,300t. in the catch.

Andamans

The total catch in Andamans during 1980 as well as the species composition did not show much variation as compared to 1979.

Lakshadweep

A decline of about 940t. in the total landings was noticed in Lakshadweep. This was mainly due to decreased landings of tunnies to the extent of about 1,030t.

Major group of fishes

From Table 2 it is seen that oil sardine accounted for 115,744t. forming about 9.3% of the total all India landings during 1980. The other major groups of species in the order of abundance are penaeid prawns (112,037t–9.0%), *Harpodon nehereus* (95,505t – 7.6%), sciaenids (89,360 t-7.2%), lesser sardines (67,053t – 5.4%), ribbon fish (62,690t–5.0%), non-penaeid prawns (58,700t–4.7%), elasmobranchs (57,862t–4.7%), mackerel (55,279 t–4.4%) and silver bellies (54,586 t–4.4%).

1. Oil sardine

The landings of oil sardine declined by about 38,000t. during 1980 as compared to 1979, the respective figures being 115,744 and 153,971t. This was mainly due to reduced landings in the states of Kerala, Tamil Nadu and Goa. Fig. 2 shows the landings of oil sardine during the years 1971 to 1980.

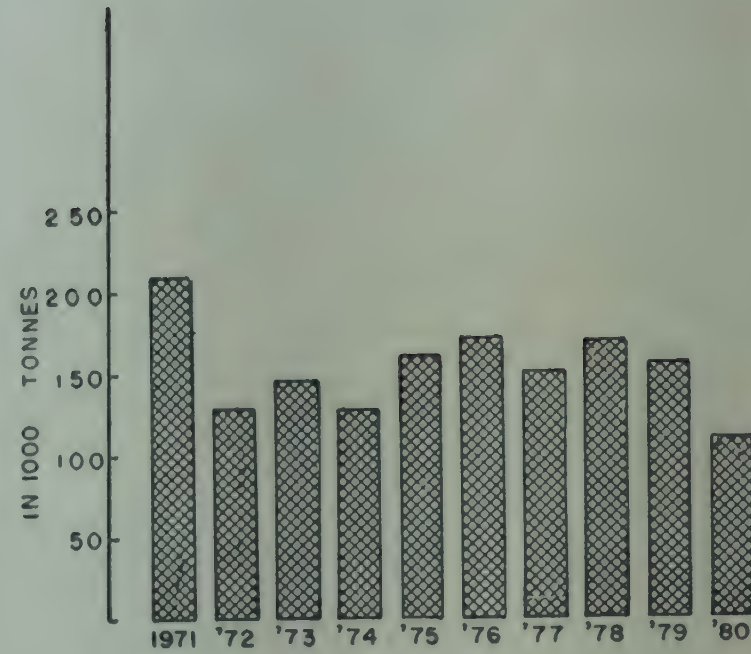

Fig. 2. Landings of oil sardine during 1971 to 1980.

2. Penaeid prawns

The catch of penaeid prawns during 1980 showed a marginal decline of about 1,600t. as compared to 1979, the corresponding figures for the two years being 112,037 and 113,665t. respectively. Except in Kerala and Gujarat, the landings of penaeid prawns declined in all the maritime States of India. In Kerala, the landings showed a significant increase of about 23,000t. The catch trends of penaeid prawns for the years 1971 to 1980 are shown in Fig. 3.

3. Harpodon nehereus

The yield of *Harpodon nehereus* showed a decline of about 31,000t. during 1980 as compared to 1979. Both Maharashtra and Gujarat recorded lower landings. The catch trends of *Harpodon nehereus* for the years 1971 to 1980 are shown in Fig. 4.

4. Sciaenids

A decrease of about 3,700t. in the landings of sciaenids was noticed during 1980 as compared to

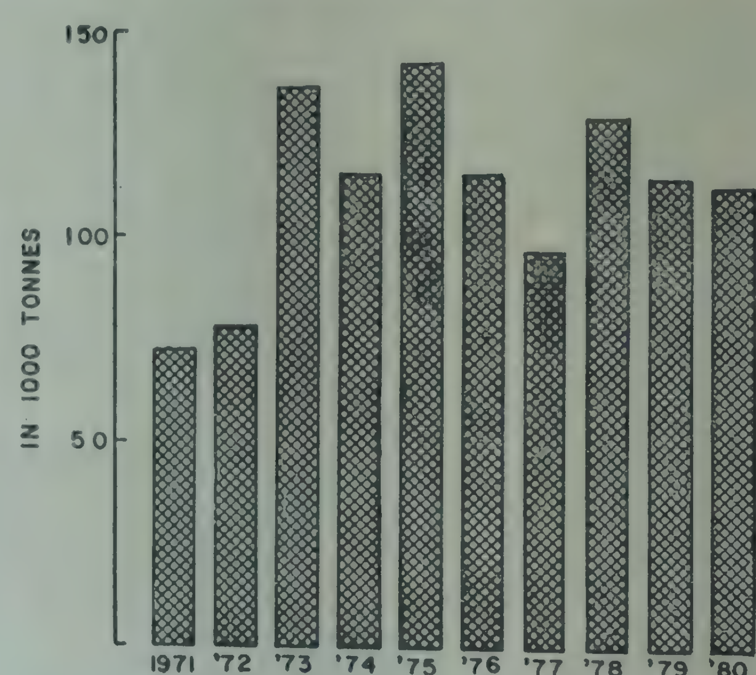

Fig. 3. Landings of penaeid prawns during 1971 to 1980.

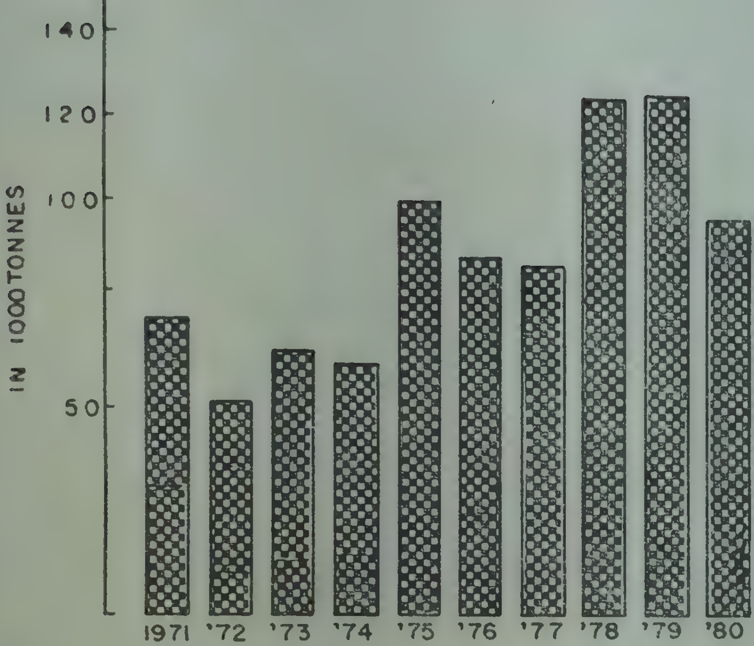

Fig. 4. Landings of *Harpodon nehereus* during 1971 to 1980.

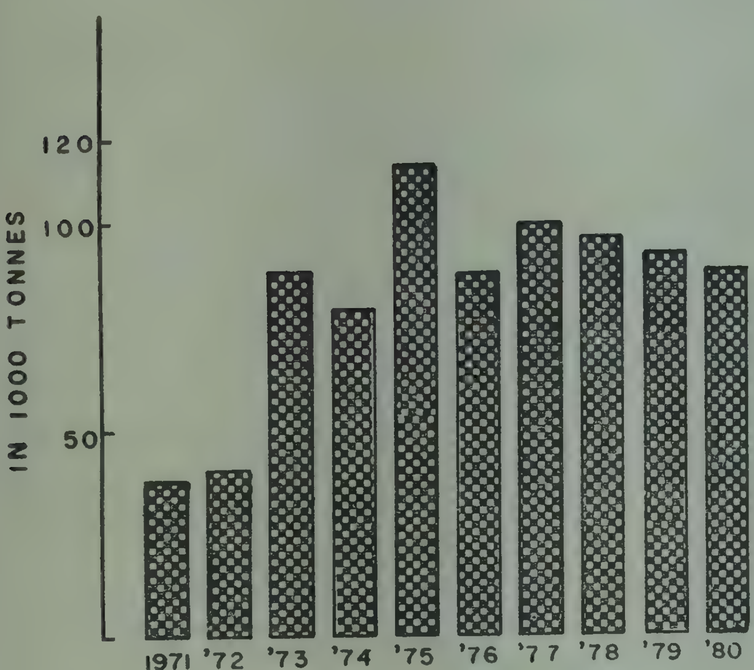

Fig. 5. Landings of sciaenids during 1971 to 1980.

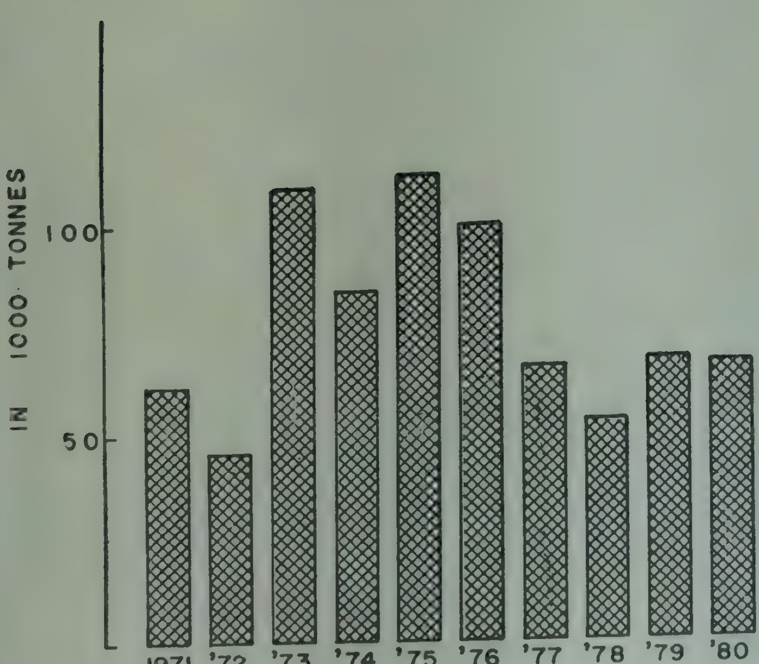

Fig. 6. Landings of lesser sardines during 1971 to 1980.

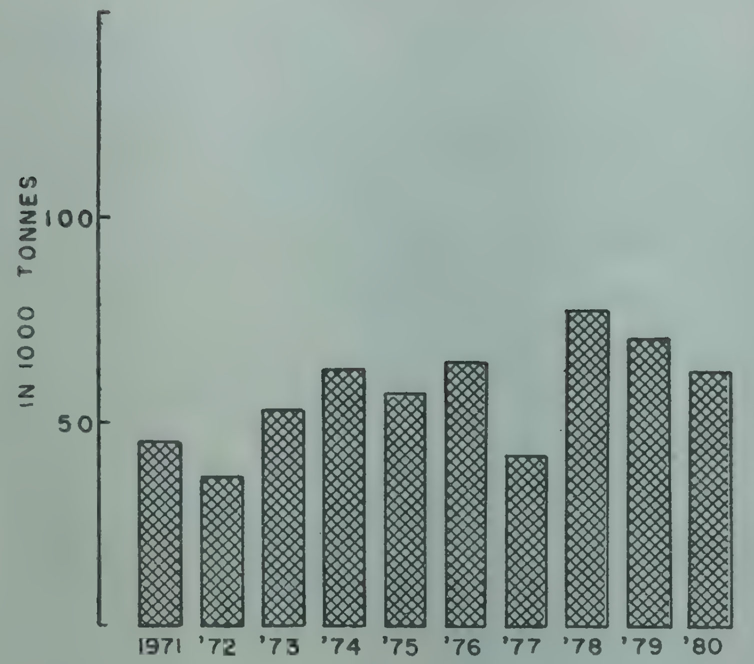

Fig. 7. Landings of ribbon fish during 1971 to 1980.

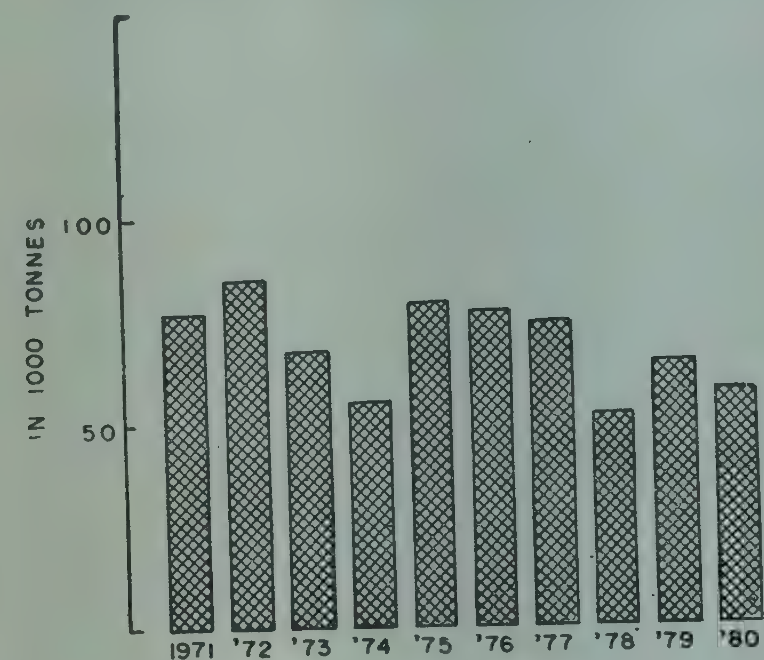

Fig. 8. Landings of non-penaeid prawns during 1971 to 1980.

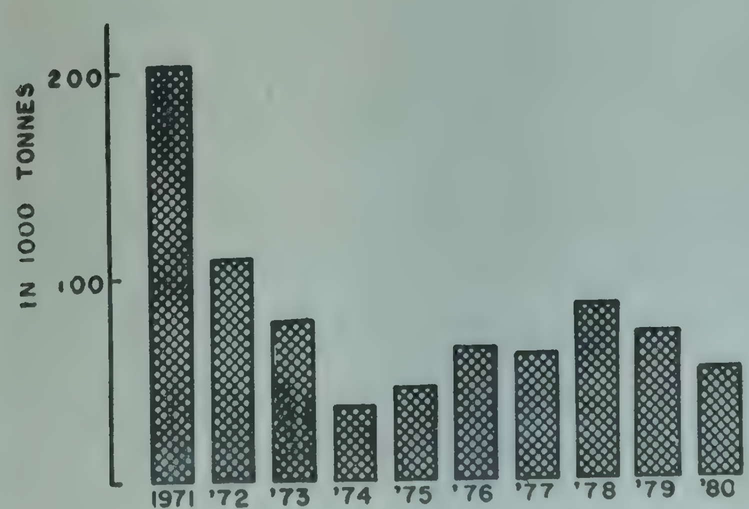

Fig. 9. Landings af mackerel during 1971 to 1980.

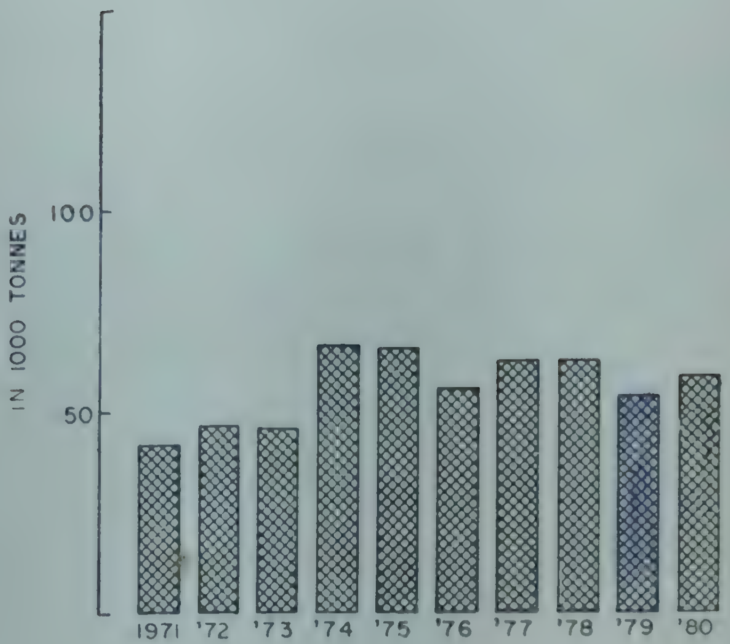

Fig. 10. Landings of elasmobranchs during 1971 to 1980.

1979. While Maharashtra, West Bengal and Orissa recorded comparatively lower catch of sciaenids, Andhra Pradesh, Tamil Nadu, Pondicherry, Kerala, Karnataka and Goa recorded higher landings. Fig. 5 shows the trends in the catch of sciaenids during the ten year period 1971 to 1980.

5. Lesser sardines

A marginal increase of about 1,300t. in the landings of lesser sardines was seen during 1980 as compared to 1979. While landings in Andhra Pradesh, Pondicherry and Maharashtra were higher, Tamil Nadu, Kerala and Karnataka recorded lower landings. The production trends in the catch of lesser sardines for the years 1971 to 1980 are shown in Fig. 6.

6. Ribbon fish

The catch of ribbon fish showed a decline of about 8,700t. during 1980 in comparison to 1979. This was mainly due to reduced landings in the states of Tamil Nadu and Kerala. Andhra Pradesh and Gujarat, however, recorded comparatively higher landings. Fig. 7 shows the landings of ribbon fish during the ten year period 1971 to 1980.

7. Non-penaeid prawns

A decline to the extent of about 5,200t. was noticed in the landings of non-penaeid prawns during 1980 in comparison to 1979. This was mainly due to decreased landings in Maharashtra. Fig. 8 shows the trends in the yield of non-penaeid prawns for the years 1971 to 1980.

8. Mackerel

A decline to the extent of about 16,000t. in the catch of mackerel was noticed during 1980 as compared to 1979, the corresponding landings during the two years respectively being 55,279, and 71,514t. Lower landings in the States of Karnataka and Goa accounted for the decline in the catch of mackerel. Fig. 9 shows the landings of mackerel during the years 1971 to 1980.

9. Elasmobranchs

The landings of elasmobranchs, during 1980 increased by about 5,000t While the catch increased in the states of Tamil Nadu, Gujarat, Karnataka and Pondicherry, reduced landings were seen in the States of Maharashtra, Andhra Pradesh, Orissa, Goa, Kerala and West Bengal. The catch trends of elasmobranchs for the years 1971 to 1980 are shown in Fig. 10.

10. Silver bellies

The landings of silver bellies showed a minor decline of about 900t. during 1980. While Tamil Nadu, Maharashtra and Orissa recorded reduced landings of silver bellies, Karnataka, Goa, Kerala and Andhra Pradesh accounted comparatively higher landings. The catch trends of silver bellies for the years 1971 to 1980 are shown in Fig. 11.

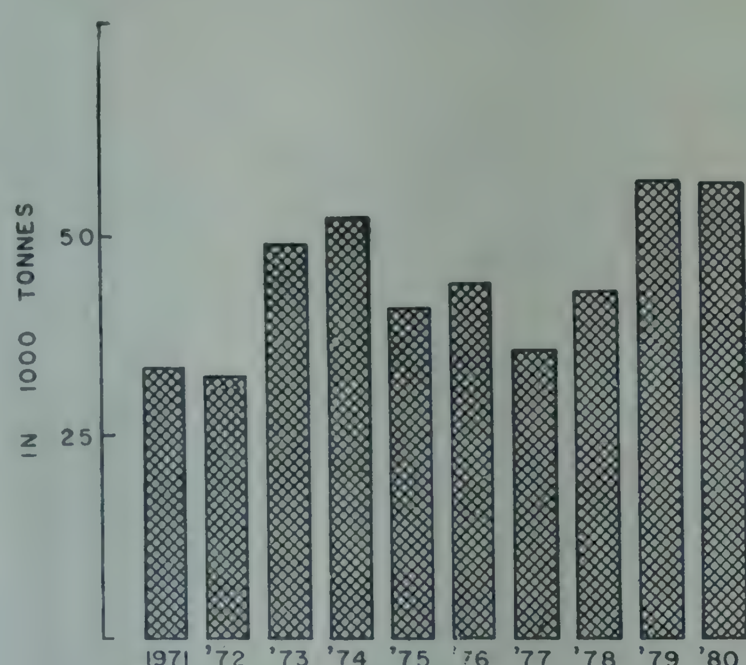

Fig. 11. Landings of silver bellies during 1971 to 1980.

INDUSTRIAL FISHERIES OFF MADRAS COAST BASED ON EXPLORATORY SURVEYS DURING 1973–1980*

In an earlier article, data on Industrial Fisheries off Visakhapatnam coast (*Mar. Fish. Infor. Serv. T & E Ser.*, No. 15, 1–15, 1980) were presented for areas lying between latitude zones 19°40′N (off Puri) and 15°40′N (off Nizampatnam) and in depths ranging from 10 to 90 m. At the Madras Research Centre of CMFRI, there existed data for areas (Fig. 1) south of 15°40′N upto the latitude zone of 10°40′N off Velanganni in depths ranging from 10 to 130 m for a eight year period from 1973 to 1980. The results of analysis of these data are presented here with a view to providing information on and extending our knowledge about the spatial and seasonal distribution of various industrially important fisheries as also their resource potential along the north Tamil Nadu–South Andhra Coast.

The authors are grateful to the Exploratory Fisheries Project (GOI), Madras for providing the Research Centre with log records of exploratory surveys carried out by their two 17.5 m trawlers M.V. *Meena Sitara* and M.V. *Meena Gaveshak* in the regions cited previously for further analysis and interpretation by the Scientists of the Madras Research Centre of CMFRI.

The following are some of the salient findings:

1. As compared with the Visakhapatnam coast, a 17.5 m vessel could yield an annual average catch of 62 tonnes of demersal fish along the Madras coast returning 657 kg/day, 216 kg/haul, 116 kg/hr and 0.58kg/hr/H.P., expending 95 days and 533.45 hrs and making 287 hauls per annum (Tables IA & B).

2. In the catches of both the vessels, silver bellies held the pride of place in most years (Tables IIA & B). Similarly the second place was invariably held by perches. While the order of importance of jew fishes, rays & skates and carangids was respectively 3, 4 and 5 in the catches of M.V. *Meena Sitara*, the corresponding ranks were held by rays & skates, carangids and jew fishes in the catches of M.V. *Meena Gaveshak*. The sixth and the seventh ranks were held by lizard fishes and thread-fin breams in the catches of M.V. *Meena Sitara*, while the order was reversed in the catches of M.V. *Meena Gaveshak*. As in the case of silver bellies and perches, the order of importance held by sharks, prawns and lobsters was always 8, 9 and 10 in the catches of both the vessels. In general, most groups witnessed two peaks of abundance during the periods from January to June and from September to December.

3. A detailed analysis to identify the most productive areas with respect to each category of fish revealed a few interesting facts (Tables III A & B). For example, among 25 productive areas that could be identified, 14 areas were productive for only one category; 2 for two categories; 4 for three categories; and 1 for four categories. The corresponding areas and categories were as follows:

a) Areas 11-79/F3; 11-80/F4, 11-79/F5 & 13-80/B4; 12-80/B2 & 13-80/B6; 12-80/C2 & 13-80/C5; 12-80/B5, 14-80/B5 & 14-80/A6; 12-80/B6, 12-80/C6 & 13-80/C3; and 12-80/C6 respectively for silver bellies, prawns, perches, rays & skates, sharks, thread-fin breams and lizard fishes.

(b) Areas 13-80/C1 and 14-80/B1 respectively for lizard fishes and lobsters, and rays & skates and jew fishes.

(c) Areas 11-79/F6, 12-80/B3, 12-80/C3 and 13-80/C6 respectively for silver bellies, rays and skates and jew fishes; perches, carangids and lobsters; jew fishes, sharks and prawns; and perches, jew fishes and carangids.

(d) Area 14-80/B2 for silver bellies, jew fishes, carangids and prawns. Whereas 'others' (miscellaneous) category was productive in areas 11-79/F5, 12-80/C3, 15-80/B2 and 15-80/D3; 'all fish' was in 11-80/A5, 12-80/C3, 14-80/B3 and 15-80/D3.

Maximum effort was expended in latitude zone 13°10′ and in area 13-80/C1 by both the trawlers.

4. The depth-wise analysis of catch rates (Tables IV A & B) revealed that maximum values for perches and jew fishes in the catches of both the vessels were obtained around 20-30 m depths. Thread-fin breams and lizard fishes were relatively more abundant in deeper areas of 50-60 m. The catch rates of prawns were high in 20-30 m depth range and of lobsters in

*Prepared by S/Shri P. T. Meenakshisundaram, J. C. Gnanamuthu, R. Sarvesan, Dr. E. Vivekanandan, M. Rajagopalan, S. Srinivasarengan, S. K. Balakumar, S. Chandrasekar and P. Thirumilu with the guidance of Dr. B. Krishnamoorthi.

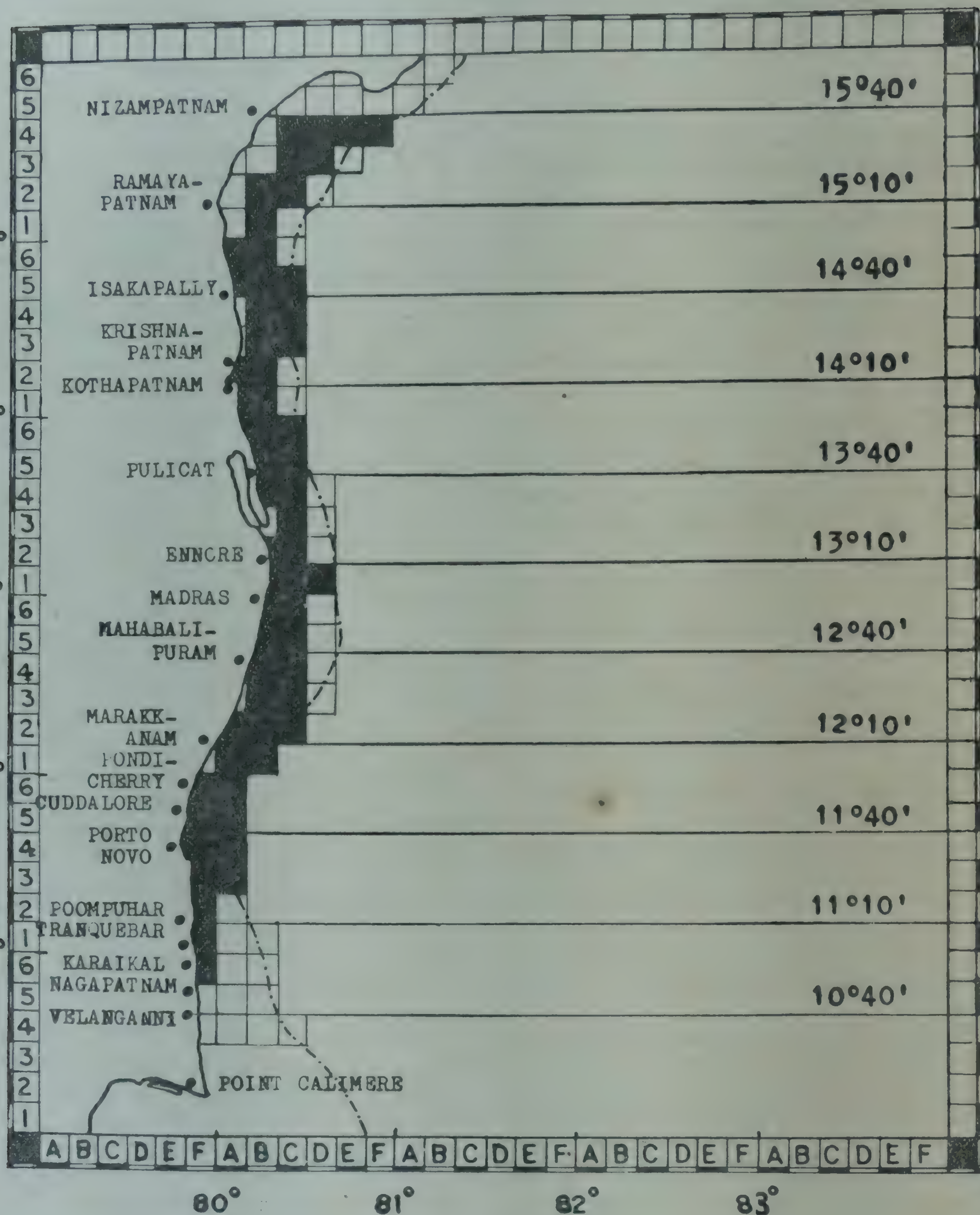

Fig. 1. Map of north Tamil Nadu-South Andhra coast. Areas surveyed are shaded.

30-40 m. The relative abundance of the remaining categories viz., silver bellies, rays & skates, carangids, sharks & others were distributed over a wide depth range. Furthermore, the shallower zones of 10-20-30 m appeared favourable for "all fish."

The deepest zone explored was 120–130 m by M.V. *Meena Gaveshak* in 1974. This depth zone

exhibited the second maximum catch rate for "all fish", with silver bellies dominating the catch. It may, however, be commented here that the effort expended by both the vessels in depths beyond 60 m was very meagre. Through the years 1973–80, maximum effort by both the vessels was deployed in depth zone 20-30 m followed by 40-50 m zone.

5. In the entire region explored, a potential yield of 1.4 t./sq.km could be expected which is one and three-fourth times higher than that estimated for the Andhra-Orissa region (0.8 t./sq.km) (Table V). The lowest yield (0.7 t./sq.km) was observed off Madras/Ennore region (13°10′). With this zone as a reference point, it was noticed that the yields increased both in the southern and northern zones, the richest among them being Ramayapatnam (2.2 t./sq.km) in the north (15°10′) and Porto-novo/Cuddalore (1.3 t./sq.km) in the south (11°40′). Similar trends were apparent with respect to yields of most categories. The exceptions were the jew fishes, the lizard fishes and the thread-fin breams. While the jew fishes were more productive in the northern zones than in the southern; in the case of both the lizard fishes and the thread-fin breams, the northern as well as the southern zones were less productive. For prawns, the most productive zones were located off Ramayapatnam (15°10′) in the north and off Porto-Novo/Cuddalore (11°40′) in the south. Furthermore, these studies have helped to establish the fact that the north Tamil Nadu-south Andhra coast is far richer than that of the north Andhra-Orissa coast.

Table 1A. *Details of exploratory trawling surveys carried out by the Government of India vessel* M. V. *Meena Sitara during the years from 1973 to 1980 (Base: Madras)*

	1973	1974	1975	1976	1977	1978	1979	1980
1. No. of Days out of Port	153	192	129	164	112	85	115	112
2. No. of Days of fishing	134	160	108	139	83	72	113	108
3. No. of hauls	370	417	310	346	259	137	217	244
4. Effort (hrs)	646.60	781.51	606.50	654.74	518.55	248.89	435.81	477.99
5. Catch (kg)	84,289	98,494.5	86,262	95,801.25	72,782.25	22,057	25,745	26,540
6. Depth range (m)	16–60	16–65	14–58	08–56	15–75	10–56	15–58	15–54
7. Catch per day out of Port (kg)	550.9	513.0	668.7	584.2	694.8	259.5	223.9	237.4
8. Catch per day of fishing (kg)	629.0	615.6	798.7	689.2	876.9	306.4	227.8	246.2
9. Catch per haul (kg)	227.8	236.2	278.3	276.9	281.0	161.0	118.6	109.0
10. Catch per hour (kg)	130.4	126.0	142.2	146.3	140.4	88.6	59.2	55.5
11. Catch per hour/h. p. (kg)	0.65	0.63	0.71	0.73	0.70	0.44	0.30	0.28
12. No. of latitude zones/No. of areas explored	8/26	9/21	6/20	6/14	3/4	4/8	3/6	5/12
13. Extent of area explored (sq. km)	8,491.57	6,858.57	6,531.97	4,572.40	1,306.39	2,612.79	1,959.60	3,919.20
14. Important categories of fishes	A,D,C,G,F	A,B,C,E,G	B,A,E,C,G	A,B,D,C,E	A,C,E,B,H	A,G,C,E,B	A,F,E,D,C	A,D,C,B,F
15. No fishing in the month(s) of	—	—	4,10,11 & 12	6	8	8,9,10 & 11	5	—

Table 1B. *Details of exploratory trawling surveys carried out by the Government of India vessel* M. V. *Meena Gaveshak during the years from 1973 to 1980 (Base: Madras)*

	1973	1974	1975	1976	1977	1978	1979	1980
1. No. of days out of Port	111	171	171	114	123	91	119	119
2. No. of days of fishing	102	146	146	93	84	72	109	112
3. No. of hauls	305	392	414	243	213	208	214	307
4. Effort (Hrs)	422.23	704.01	751.24	441.10	386.96	406.48	419.02	631.58
5. Catch (kg)	70,916	81,104.5	1,11,800	54,254	51,166	38,082	23,463.5	50,657.5
6. Depth range (m)	14–100	12–125	13–50	20–60	12–56	14–60	16–60	14–56
7. Catch per day out of Port (kg)	638.9	474.3	653.8	475.9	416.0	418.52	197.1	425.7
8. Catch per day of fishing (kg)	695.3	555.5	765.8	583.4	609.1	528.9	215.3	452.3
9. Catch per haul (kg)	232.5	206.9	270.0	223.3	240.2	183.1	109.6	165.0
10. Catch per hour (kg)	168.0	115.2	148.8	123.0	132.2	93.7	55.8	80.2
11. Catch per hour/h.p. (kg)	0.84	0.58	0.74	0.56	0.66	0.47	0.28	0.40
12. No. of latitude zones/No. of Areas explored	7/27	9/25	6/24	5/14	8/19	5/16	3/5	5/14
13. Extent of area explored (sq km)	8,818.17	8,164.97	7,838.37	4,572.40	6,205.38	5,225.58	1,632.99	4,572.40
14. Important categories of fishes	A,C,F,G,D	A,B,E,C,F	A,B,E,C,G	A,E,C,B,F	A,C,E,B,D	A,C,E,G,F	A,E,F,D,C	A,D,C,F,B
15. No Fishing in the month(s) of	11	7	—	1,2,3 & 4	8 & 9	10,11 & 12	5	11 & 12

Table IIA: *Total catches in kg (1); Catch rates in kg/hr (2); percentages (3) and months of abundance (4) of various categories of fishes as obtained from the exploratory surveys of* M. V. *Meena Sitara during the years from* 1973 *to* 1980 *(Base: Madras)*

Categories	1973				1974				1975				1976			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
A. Silver bellies	11,326	17.5	13.4	2,6,7,12	24,615	31.5	25.0	2,3,6	18,815	31.0	21.8	1,2,7	25,034	38.2	26.1	2,9
B. Perches	—	—	—	—	2,850	3.7	2.9	1,5	19,452	32.1	22.5	2,7,9	16,283	24.9	17.0	2,9
C. Rays & Skates	4,871	7.5	5.8	1,2,3,5,8	2,455	3.1	2.5	2,7,11	3,195	5.3	3.7	1,3,7	6,016	9.2	6.3	1,7,9
D. Jew fishes	10,011	15.5	11.9	7,8,9	—	—	—	—	—	—	—	—	9,125	13.9	9.5	2,7
E. Carangids	—	—	—	—	2,033.5	2.6	2.1	2,4	3,592	5.9	4.2	2,9	2,868	4.4	3.0	2,8,9,11
F. Thread-fin breams	1,606	2.5	1.9	8	1,268	1.6	1.3	5,9,10	1,670	2.8	1.9	6,7,8	1,158	1.8	1.2	8,10
G. Lizard fish	2,562	4.0	3.0	6,7,8,9	2,012	2.6	2.0	6,7	3,051	5.0	3.5	6,7,8	269	0.4	0.3	5
H. Sharks	859	1.3	1.0	4	899	1.2	0.9	4	397	0.7	0.5	7,8	226	0.3	0.2	7
I. Prawns	109.5	0.2	0.1	3,9	73.5	0.1	0.1	1,10	70	0.1	0.1	2	74.25	0.1	0.1	3,9
J. Lobsters	—	—	—	—	20.5	0.03	0.02	12	43	0.1	0.04	6	31	0.04	0.03	8
K. Others	52,944.5	81.9	62.9	3,7,9	62,268	29.7	63.2	2,7,9	35,977	59.3	41.7	2,5,8	34,717	53.1	36.2	3,9
ALL FISH	84,289	130.4			98,494.5	126.0			86,262	142.2			95,801.25	146.3		

Categories	1977				1978				1979				1980			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
A. Silver bellies	57,834	111.5	79.5	1,5,9	5,611	22.5	25.4	1,2,4	8,715	20.0	33.9	1,4,6,12	13,460	28.2	50.7	2,7,8,11
B. Perches	503	1.0	0.8	6,7,10	241	1.0	1.1	4	49	0.1	0.2	9	1,358	2.8	5.1	2,8
C. Rays & Skates	3,592	6.9	4.9	1,4,6,10	976	3.9	4.4	1,2,5	906	2.1	3.5	2,9	1,781	3.7	6.7	3,5,8
D. Jew fishes	840	1.6	1.1	1,3	—	—	—	—	1,944	4.6	7.6	2,6	3,415	7.1	12.9	2,5
E. Carangids	1,491	2.9	2.0	1,6,10	405	1.6	1.8	1,3,5	3,033	7.0	11.9	7,8	593	1.2	2.2	2,8
F. Thread-fin breams	64	0.1	0.09	10	8	0.03	0.04	4	3,260	7.5	12.6	7,8,9,10	958	2.0	3.6	4,8
G. Lizard fish	5	0.01	0.01	1	1,278	5.1	5.8	5,6	591	1.4	2.3	11,12	641	1.3	2.4	1,4
H. Sharks	477.5	0.09	0.7	4,5	83	0.3	0.4	1,4,6	172	0.4	0.7	2,3	110	0.2	0.4	2,8
I. Prawns	94	0.3	0.1	1	—	—	—	—	9	1.02	0.03	9	—	—	—	—
J. Lobsters	21	0.04	0.03	1	—	—	—	—	—	—	—	—	—	—	—	—
K. Others	7,890.75	15.2	10.8	3,7,10	13,455	54.1	61.0	1,6,7	7,016	16.1	27.3	2,8	4,224	8.8	15.9	2,5,9
ALL FISH	72,782.25	140.4			22,057	88.6			25,745	59.2			26,540	55.5		

Table IIB. *Total catches in kg (1); Catch rates in kg/hr (2); Percentages (3) and months of abundance (4) of various categories of fishes as obtained from the exploratory surveys of* M. V. *Meena Gaveshak during the years from* 1973 *to* 1980 *(Base: Madras)*

Categories	1973				1974				1975				1976			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
A. Silver bellies	11,687	27.7	16.5	3,7,9,12	17,873	25.4	22.0	1,3,12	33,518	44.6	30.0	2,7,11	22,562	51.2	41.6	6,9
B. Perches	—	—	—	—	4,480	6.4	5.5	1,9	24,783	33.0	22.2	2,9	1,780	4.0	3.3	6,10
C. Rays & Skates	3,748	8.9	5.3	4,8	2,141	3.0	2.6	3,12	3,842	5.1	3.5	1,8	2,311	5.2	4.3	6,9
D. Jew fishes	2,309	5.5	3.3	3,7,9,10	—	—	—	—	—	—	—	—	1,166	2.6	2.1	7
E. Carangids	—	—	—	—	2,478	3.5	3.1	4,9,12	4,070	5.4	3.6	2,7,9	2,348	5.3	4.3	6,9
F. Thread-fin breams	2,562	6.1	3.6	6,7,9	1,325	1.9	1.6	1,8	1,347	1.8	1.2	1,3,11	1,602	3.6	3.0	6,12
G. Lizard fish	2,509	5.9	3.5	6,7	957	1.4	1.2	1,6,8	2,549	3.4	2.5	6,12	768	1.8	1.4	5
H. Sharks	513	1.2	0.7	2,7,9	451	0.6	0.6	4	365	0.5	0.3	6,10	1,310	3.0	2.4	7
I. Prawns	228	0.5	0.3	4,7	38	0.1	0.1	9	59	0.1	0.05	8,12	60	0.1	0.1	8
J. Lobsters	—	—	—	—	21.5	0.03	0.03	1,9,12	32	0.04	0.02	1,6	51.5	0.1	0.1	9
K. Others	47,360	112.2	66.8	1,7,9	51,340	72.9	63.3	1,9,12	41,235	54.9	36.9	4,7,12	20,295.5	46.1	37.4	6,10
ALL FISH	70,916	168.0			81,104.5	115.2			1,11,800	148.8			54,254	123.0		

Categories	1977				1978				1979				1980			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
A. Silver bellies	38,511	99.5	75.3	1,3	5,300	13.0	13.9	4,6	6,754	16.1	28.8	2,11,12	16,777	26.6	33.1	2,5,8
B. Perches	350	0.9	0.7	6	594	1.5	1.6	1,3,7	140	0.3	0.6	6	2,071	3.3	4.1	3,7
C. Rays & Skates	4,773.5	12.3	9.3	3,5	3,683	9.1	9.7	3,6	1,250	2.9	5.3	6,10	5,137	8.1	10.2	3,6
D. Jew fishes	346	0.9	0.7	1,3	—	—	—	—	1,711	4.1	7.3	6,7	10,890	17.2	21.5	2,6,8
E. Carangids	1,136	2.9	2.2	2,3	1,516	3.7	4.0	2,7	4,153	9.9	17.7	7,8	1,551	2.5	3.1	2,8
F. Thread-fin breams	7	0.02	0.01	1	613	1.5	1.6	7	1,974	4.7	8.4	7,9	2,339	3.7	4.6	1,8
G. Lizard fish	—	—	—	—	1,174	2.9	3.1	8	1,189	2.8	5.1	12	1,635	2.6	3.2	1,5,9
H. Sharks	40	0.1	0.1	6	171	0.4	0.5	6	104	0.2	0.4	10	242.5	0.4	0.5	1,9
I. Prawns	38.5	0.1	0.08	1	—	—	—	—	66	0.2	0.3	7	19	0.03	0.04	7
J. Lobsters	13	0.03	0.03	2	—	—	—	—	3	0.01	0.01	11	—	—	—	—
K. Others	5,951	15.4	11.6	2,5	25,031	61.6	65.7	2,6	6,119.5	14.6	26.1	8,12	9,996	15.8	19.7	2,8
ALL FISH	51,166	132.2			38,082	93.7			23,463.5	55.8			50,657.5	80.2		

Table III A. *Areas of abundance in terms of annual catch-rate (kg/hr) in respect of major categories of fishes as obtained from the exploratory surveys of* M.V. *Meena Sitara during the years from* 1973 *to* 1980 *(Base: Madras)*

Latitude/Areas	A. SILVER BELLIES										B. PERCHES									
	1973	1974	1975	1976	1977	1978	1979	1980	All years Area	All years Lat.	1973	1974	1975	1976	1977	1978	1978	1980	All years Area	All years Lat.
11°40′																				
11–79/F5	0.0	0.0		170.8					59.39		0.0	5.6		7.5					5.17	
11–79/F6	0.0			280.0					189.83	110.36	0.0			4.6					3.12	4.37
12°10′																				
12–80/A1	33.3								33.33		0.0								0.00	
12–80/A2	11.1		33.0						22.63		0.0		20.0						10.53	
12–80/B2	41.1		47.0						43.24		0.0		43.5						15.87	
12–80/B3	29.4	0.0	30.4						21.39		0.0	10.8	27.9						14.97	
12–80/C3	0.0								0.00	23.41	0.0								0.00	11.68
12°40′																				
12–80/B4	139.4	0.0	42.6	37.2		51.4			46.43		0.0	4.0	16.2	1.6		6.3			7.47	
12–80/C4	16.4								16.36		0.0								0.00	
12–80/B5			0.0			50.0			8.33				2.0			5.0			2.50	
12–80/C5	15.9							28.0	18.18		0.0							0.0	0.00	
12–80/B6	26.7								26.67		0.0								0.00	
12–80/C6	17.8	57.1		16.7		1.6	22.2	33.7	22.90	25.16	0.0	0.5		0.0		0.2	0.0	0.1	0.04	0.93
13°10′																				
13–80/B1	21.8		36.8				44.6		38.44		0.0		0.0				0.0		0.00	
13–80/C1	8.2	44.4	16.3	18.5	70.1	29.7	13.3	26.1	31.94		0.0	0.2	0.2	1.3	0.01	0.03	0.04	0.1	0.25	
13–80/B2	15.6								15.63		0.0								0.00	
13–80/C2	5.1	32.1	19.8	50.8			12.5	18.3	20.60		0.0	0.2	4.2	0.0			0.0	0.8	0.73	
13–80/C3		28.6		31.1			13.4	13.6	19.42	30.14		0.8		0.6			1.4	2.6	1.61	0.35
13°40′																				
13–80/C4	80.0	18.8	0.0	0.0			17.1	37.8	21.57		0.0	4.6	50.3	2.4			0.9	5.0	7.23	
13–80/B5	42.6		44.2	6.7		0.0			32.51		0.0		34.4	12.8		0.0			25.35	
13–80/C5		18.9	35.8	26.2		10.6		51.0	28.86			11.1	39.6	21.0		3.4		3.2	24.24	
13–80 B6			23.9	15.6					22.63				32.9	44.4					34.69	
13–80/C6		47.5	33.3	93.5					71.94	40.80		6.1	25.5	88.8					61.34	34.29
14°10′																				
14–80/A1								8.0	8.00									3.2	3.20	
14–80/B1			15.5					55.6	32.37				15.5					9.5	12.95	
14–80/B2	17.8	0.0	49.9	23.6	140.7	18.0		42.1	60.60		0.0	7.8	137.5	34.0	0.8	5.1		13.4	26.97	
14–80/B3	0.0	3.5	21.3		128.9	0.0		28.8	68.30	63.10	0.0	7.1	74.4		1.6	0.0		25.8	14.67	21.06
14°40′																				
14–80/B4	0.0	0.0	47.7	18.8	127.5			20.4	64.40		0.0	15.3	36.0	1.6	2.3			5.9	10.20	
14–80/C4	0.0								0.00		0.0								0.00	
14–80/A5		0.0							0.00			18.7							18.70	
14–80/B5		8.8	50.0						13.27			8.3	56.3						13.55	
14–80/A6		186.3							186.29			0.0							0.00	
14–80/B6	48.5	13.9	83.8						41.26	48.70	0.0	4.9	0.0						2.14	9.63
15°10′																				
15–80/B1	23.9								23.88		0.0								0.00	
15–80/B2	22.9								22.91		0.0								0.00	
15–80/C2	100.0								100.00		0.0								0.00	
15–80/D3		28.6							28.60	27.94		11.3							11.25	1.30
15°40′																				
15–80/D4		0.0							0.00			19.0							19.00	
15–80/E4		0.0							0.00			13.1							13.08	
15–80/F4		0.0							0.00	0.00		20.0							20.00	16.68
All Latds./Areas	17.5	31.5	31.0	38.2	111.5	22.5	20.0	28.2	37.85	37.85	0.0	3.7	32.1	24.9	1.0	1.0	0.1	2.8	9.32	9.32

Table III A. (Continued.)

Latitude/Areas	C. RAYS & SKATES 1973	1974	1975	1976	1977	1978	1979	1980	All years Area	All years Lat.	D. JEW FISHES 1973	1974	1975	1976	1977	1978	1979	1980	All years Area	All years Lat.
11°40′																				
11–79/F5	0.0	0.9		9.3					3.61		5.6	0.0		0.0					1.09	
11–79/F6	0.0			22.8					15.46	8.24	2.5			0.0					0.81	0.98
12°10′																				
12–80/A1	1.1								1.11		4.0								4.00	
12–80/A2	8.3		0.0						2.63		2.8		0.0						1.32	
12–80/B2	7.5		0.0						4.76		2.0		0.0						1.27	
12–80/B3	5.0	6.7	2.3						4.31		20.3	0.0	0.0						5.82	
12–80/C3	6.6								6.64	4.16	27.3								27.27	6.59
12°40′																				
12–80/B4	5.2	0.0	2.3	17.8		10.3			9.26		81.9	0.0	0.0	18.6		0.0			21.79	
12–80/C4	50.5								50.50		5.7								5.71	
12–80/B5			0.0			0.0			0.00				0.0			0.0			0.00	
12–80/C5	12.1							0.0	9.87		0.0							0.0	0.00	
12–80/B6	0.0					0.0			0.00		0.0								0.00	
12–80/C6	6.6	1.9		0.7			0.8	1.2	3.00	4.71	3.8	0.0		0.5		0.0	4.7	0.0	2.55	4.71
13°10′																				
13–80/B1	10.2		0.0				0.8		3.17		3.7		0.0				0.0		0.95	
13–80/C1	7.4	2.8	4.0	2.7	2.0	3.3	1.5	1.9	3.00		34.5	0.0		1.0	0.0	0.0	4.7	0.0	3.43	
13–80/B2	3.0								3.02		1.7								1.72	
13–80/C2	5.9	4.1	0.7	0.0			0.5	0.4	1.84		0.0	0.0	0.0	8.3			15.7	0.8	2.86	
13–80/C3		1.0		10.0			13.7	5.4	7.05	3.03		0.0		0.6			0.0	7.2	2.87	3.21
13°40′																				
13–80/C4	0.0	6.3	0.0	41.3			11.6	9.5	13.45		10.5	0.0	0.0	0.0			0.0	25.0	7.74	
13–80/B5	7.1		4.9	9.1		12.5			6.44		28.4		0.0	3.0		0.0			2.50	
13–80/C5		23.4	0.03	21.5		13.5		2.8	14.22			0.0	0.0	9.8		0.0		25.5	5.90	
13–80/B6			3.4	5.0					3.67				0.0	16.9					2.61	
13–80/C6		1.7	6.4	7.6					6.46	9.26		0.0	0.0	44.7					27.21	11.34
14°10′																				
14–80/A1								40.0	40.00									8.0	8.00	
14–80/B2			36.4					14.6	27.21				0.0					56.4	23.74	
14–80/B2	2.9	0.0	4.5	9.6	5.8	7.2		11.9	6.84		2.1	0.0	0.0	21.2	2.6	0.0		33.0	10.14	
14–80/B3	5.7	2.4	10.1		10.7	0.0		13.7	8.80	8.36	7.5	0.0	0.0		2.5	0.0		43.7	5.54	8.45
14°40′																				
14–80/B4	5.3	5.0	7.9	4.3	12.6			15.0	9.20		1.5	0.0	0.0	0.0	1.6			17.5	1.96	
14–80/C4	0.0								0.00		0.3								0.33	
14–80/A5		0.0							0.00			0.0							0.00	
14–80/B5		3.8	25.0						6.12			0.0	0.0						0.00	
14–80/A6		0.0							0.00			0.0							0.00	
14–80/B6	22.4	5.6	0.0						10.02	7.95	36.0	0.0	0.0						12.16	2.87
15°10′																				
15–80/B1	5.4								5.37		26.8								26.83	
15–80/B2	6.3								6.25		44.5								44.46	
15–80/C2	0.0								0.00		28.6								28.57	
15–80/D3		0.0							0.00	4.78		0.0							0.00	29.94
15°40′																				
15–80/D4		4.0							4.00			0.0							0.00	
15–80/E4		0.0							0.00			0.0							0.00	
15–80/F4		7.2							7.17	2.96		0.0							0.00	0.00
All Latds./Areas	7.5	3.1	5.3	9.2	6.9	3.9	2.1	3.7	5.44	5.44	15.5	0.0	0.0	13.9	1.6	0.0	4.6	7.1	5.80	5.80

Table III A. (Continued)

Latitude/Areas	E. CARANGIDS 1973	1974	1975	1976	1977	1978	1979	1980	All years Area	Lat.	F. THREAD-FIN BREAMS 1973	1974	1975	1976	1977	1978	1979	1980	All years Area	Lat.
11°40′																				
11–79/F5	0.0	2.9		3.1					2.39		0.0	0.0		0.0					0.00	
11–79/F6	0.0			1.9					1.29	1.96	0.0			0.0					0.00	0.00
12°10′																				
12–80/A1	0.0								0.00		0.0								0.00	
12–80/A2	0.0		3.0						1.58		0.0		2.3						1.21	
12–80/B2	0.0		10.4						3.81		0.0		2.6						0.95	
12–80/B3	0.0	5.4	9.6						5.63		0.0	0.0	7.4						3.16	
12–80/C3	0.0								0.00	3.53									0.00	1.85
12°40′																				
12–80/B4	0.0	3.4	11.8	0.2		2.6			4.91		1.5	0.0	9.4	0.0		0.0			3.77	
12–80/C4	0.0								0.00		2.5								0.86	
12–80/B5			6.6			3.0			6.00				22.0			0.0			18.33	
12–80/C5	0.0							0.0	0.00		1.3							0.0	1.05	
12–80/B6	0.0								0.00		2.2								2.22	
12–80/C6	0.0	0.0		2.9		0.6	1.4	0.04	0.53	1.10	1.9	0.6		7.4		0.2	3.7	0.1	2.05	2.48
13°10′																				
13–80/B1	0.0		0.0				0.6		0.41		5.8		0.0				2.6		3.26	
13–80/C1	0.0	0.9	4.0	1.9	1.0	0.5	16.0	0.3	2.99		5.7	1.4	4.4	4.1	0.1	0.0	10.5	1.4	3.16	
13–80/B2	0.0								0.00		3.3								3.26	
13–80/C2	0.0	0.9	2.8	0.0			0.1	0.9	0.80		2.5	0.7	1.0	0.0			1.3	4.5	2.51	
13–80/C3		1.5		0.5			0.7	1.2	1.03	2.51		0.4		1.8			21.0	3.3	6.75	3.23
13°40′																				
13–80/C4	0.0	1.3	5.0	7.0			0.7	2.5	2.61		8.0	1.0	0.0	0.0			8.5	2.2	6.64	
13–80/B5	0.0		4.8	4.7		9.3			4.62		3.8		0.5	0.6		0.0			0.70	
13–80/C5		5.3	5.9	8.2		7.6		1.5	6.87			0.2	0.4	0.4		0.0		0.0	0.31	
13–80/B6			6.4	7.5					6.55				0.0	0.0					0.00	
13–80/C6		7.1	4.9	9.5					8.02	6.21		0.0	0.9	0.0					0.22	1.08
14°10′																				
14–80/A1								2.4	2.40									0.0	0.00	
14–80/B1			8.3					7.9	8.10				0.0					5.0	2.10	
14–80/B2	0.0	3.7	11.1	4.0	3.3	4.6		7.7	4.54		2.2	16.6	0.02	1.3	0.1	0.0		4.4	2.19	
14–80/B3	0.0	2.4	6.4		3.8	4.4		4.1	3.53	4.18	1.0	1.2	0.9		0.2	0.0		1.9	0.67	1.51
14°40′																				
14–80/B4	0.0	3.0	5.1	0.0	4.6			4.1	3.46		2.1	3.5	0.0	0.0	0.2			4.2	0.89	
14–80/C4	0.0								0.00		2.8								2.83	
14–80/A5		13.2							13.20			0.0							0.00	
14–80/B5		9.0	16.3						9.82			0.0							0.00	
14–80/A6		8.6							8.57			0.0							0.00	
14–80/B6	0.0	2.2	0.0						0.96	4.90	3.8	0.0	19.0						5.56	1.36
15°10′																				
15–80/B1	0.0								0.00		0.5								0.54	
15–80/B2	0.0								0.00		0.0								0.00	
15–80/C2	0.0								0.00		0.0								0.00	
15–80/D3		13.6							13.63	1.58		0.0							0.00	0.26
15°40′																				
15–80/D4		3.8							3.80			0.0							0.00	
15–80/E4		2.1							2.08			0.0							0.00	
15–80/F4		0.0							0.00	2.25		0.0							0.00	0.00
All Latds./Areas	0.0	2.6	5.9	4.4	2.9	1.6	7.0	1.2	3.21	3.21	2.5	1.6	2.8	1.8	0.1	0.03	7.5	2.0	2.29	2.29

Table III A. (Continued)

Latitude/Areas	G. LIZARD FISHES 1973	1974	1975	1976	1977	1978	1979	1980	All years Area	All years Lat.	H. SHARKS 1973	1974	1975	1976	1977	1978	1979	1980	All years Area	All years Lat.
11°40′																				
11–79/F5	0.0	0.0		0.0					0.00		0.0	0.0		0.0					0.00	
11–79/F6	0.0			0.0					0.00	0.00	0.0			0.0					0.00	0.00
12°10′																				
12–80/A1	0.0								0.00		1.1								1.11	
12–80/A2	0.0		0.0						0.00		0.6		0.0						0.26	
12–80/B2	0.0		0.0						0.00		0.0		0.0						0.00	
12–80/B3	0.0	0.0	9.6						4.07		0.4	0.0	4.5						2.04	
12–80/C3	0.0								0.00	1.85	3.6								3.64	1.47
12°40′																				
12–80/B4	0.6	0.0	10.6	0.0		0.0			3.96		7.9	0.0	1.8	1.8		0.0			2.01	
12–80/C4	2.1	0.0							2.14		0.8								0.79	
12–80/B5			18.8			0.0			15.67				7.0			0.0			5.83	
12–80/C5	3.1							0.0	2.54		0.4							0.0	0.30	
12–80/B6	1.1								1.11		0.0								0.00	
12–80/C6	5.6			0.0		5.6	2.0	1.3	3.20	3.46	0.7	1.0		0.3		1.1	0.1	0.1	0.41	0.69
13°10′																				
13–80/B1	0.7		0.0				0.1		0.27		0.0		0.0				0.0		0.00	
13–80/C1	10.2	5.1	15.5	0.7	0.03	5.8	1.8	1.2	4.74		0.7	0.5	0.2	0.2	1.2	0.3	0.4	0.3	0.49	
13–80/B2	2.7								2.74		0.0								0.00	
13–80/C2	3.1	0.3	8.4	0.0			0.0	1.5	1.70		0.0	0.0	0.0	3.3			1.8	0.3	0.48	
13–80/C3		0.0		0.0			0.0	2.1	0.81	4.01		0.2		0.0			0.6	0.3	0.28	0.46
13°40′																				
13–80/C4	0.0	0.0	0.0	0.0			0.0	1.5	0.45		0.0	0.9	3.3	0.0			0.6	0.6	0.77	
13–80/B5	0.0		0.0	0.0		0.0			0.00		0.0		0.3	0.3		0.0			0.25	
13–80/C5		0.0	0.0	0.2		4.6		11.5	1.01			1.8	0.8	0.6		0.0		0.0	0.70	
13–80/B6			0.0	0.0					0.00				0.5	1.0					0.54	
13–80/C6		0.0	0.0	0.0					0.00	0.34		2.3	0.7	0.03					0.52	0.55
14°10′																				
14–80/A1								0.0	0.00									0.0	0.00	
14–80/B1		0.0	0.0					0.0	0.00				0.0					0.0	0.00	
14–80/B2	0.0	0.0	0.0	0.0	0.0	5.2		0.0	0.34		4.6	0.6	0.02	0.04	0.04	0.0		0.5	0.31	
14–80/B3	0.0	0.0	0.0		0.0	0.0		0.0	0.00	0.18	5.4	1.9	0.2		1.6	0.0		0.2	1.83	0.97
14°40′																				
14–80/B4	0.0	0.0	0.0	5.0	0.0			0.0	0.79		5.0	4.0	1.7	0.9	0.0			0.4	1.04	
14–80/C4	0.0								0.00		6.7								6.67	
14–80/A5		0.0							0.00			11.1							11.10	
14–80/B5		0.0	0.0						0.00			3.6	1.3						3.32	
14–80/A6		0.0							0.00			5.7							5.71	
14–80/B6	0.0	0.0	0.0						0.00	0.44	0.0	0.0	0.0						0.00	1.94
15°10′																				
15–80/B1	0.0								0.00		2.1								2.06	
15–80/B2	0.0								0.00		1.5								1.50	
15–80/C2	0.0								0.00		0.0								0.00	
15–80/D3		0.0							0.00	0.00		3.5							3.50	1.93
15°40′																				
15–80/D4		0.0							0.00			0.0							0.00	
15–80/E4		0.0							0.00			0.0							0.00	
15–80/F4		0.0							0.00	0.00		0.0							0.00	
All Latds./Areas	4.0	2.6	5.0	0.4	0.01	5.1	1.4	1.3	2.38	2.38	1.3	1.2	0.7	0.3	0.9	0.3	0.4	0.2	0.74	0.74

Table III A. (Continued)

Latitude/Areas	I. PRAWNS										J. LOBSTERS									
	1973	1974	1975	1976	1977	1978	1979	1980	All years Area	All years Lat.	1973	1974	1975	1976	1977	1978	1979	1980	All years Area	All years Lat.
11°40′																				
11–79/F5	0.0	0.0		0.0					0.00		0.0	0.0		0.0					0.00	
11–79/F6	0.0			0.0					0.00	0.00	0.0			0.0					0.00	0.00
12°10′																				
12–80/A1	0.0								0.00		0.0								0.00	
12–80/A2	0.0		0.0						0.00		0.0		0.0						0.00	
12–80/B2	0.0		0.0						0.00		0.0		0.0						0.00	
12–80/B3	0.0	0.0	0.0						0.00		0.0	0.0	0.0						0.00	
12–80/C3	3.1								3.09	0.37	0.0								0.00	0.00
12°40′																				
12–80/B4	0.3	0.2	0.03	0.0		0.0			0.05		0.0	0.0	0.0	0.0		0.0			0.00	
12–80/C4	0.0								0.00		0.0								0.00	
12–80/B5			0.0			0.0			0.00			0.0				0.0			0.00	
12–80/C5	0.0							0.0	0.00		0.0							0.0	0.00	
12–80/B6	0.0								0.00		0.0								0.00	
12–80/C6	0.03	0.3		0.1		0.0	0.0	0.0	0.03	0.03	0.0	0.0		0.1		0.0	0.0	0.0	0.01	0.004
13°10′																				
13–80/B1	0.0		0.0				0.0		0.00		0.0		0.0				0.0		0.00	
13–80/C1	0.1	0.02	0.0	0.0	0.0	0.0	0.0	0.0	0.01		0.0	0.1	0.2	0.1	0.0	0.0	0.0	0.0	0.04	
13–80/B2	0.04								0.05		0.0								0.00	
13–80/C2	0.0	0.06	0.4	0.0			0.0	0.0	0.05		0.0	0.02	0.0	0.0			0.0	0.0	0.01	
13–80/C3		0.1		0.0			0.2	0.0	0.07	0.02		0.0		0.0			0.0	0.0	0.00	0.03
13°40′																				
13–80/C4	0.0	0.0	0.0	0.0			0.3	0.0	0.09		0.0	0.0	0.0	0.0			0.0	0.0	0.00	
13–80/B5	0.0		0.02	0.1		0.0			0.03		0.0		0.0	0.0		0.0			0.00	
13–80/C5		0.0	0.05	0.1		0.0		0.0	0.07			0.0	0.0	0.1		0.0		0.0	0.04	
13–80/B6			0.0	0.0					0.00					0.0					0.00	
13–80/C6		0.0	0.4	0.2					0.23	0.10		0.0	0.0	0.04					0.02	0.02
14°10′																				
14–80/A1								0.0	0.00									0.0	0.00	
14–80/B1			0.0					0.0	0.00				0.0					0.0	0.00	
14–80/B2	0.3	0.2	0.7	0.3	0.3	0.0		0.0	0.30		0.0	0.0	0.02	0.01	0.03	0.0		0.0	0.02	
14–80/B3	0.0	0.3	0.2		0.3	0.0		0.0	0.20	0.25	0.0	0.0	0.02		0.1	0.0		0.0	0.04	0.03
14°40′																				
14–80/B4	0.0	0.2	0.08	0.0	0.2			0.0	0.11		0.0	0.0	0.0	0.0	0.1			0.0	0.02	
14–80/C4	0.0								0.00		0.0								0.00	
14–80/A5		0.0							0.00			0.0							0.00	
14–80/B5		0.2	0.0						0.17			0.0	0.0						0.00	
14–80/A6		0.0							0.00			0.0							0.00	
14–80/B6	1.0	0.1	0.1						0.40	0.16	0.0	0.0	0.9						0.19	0.04
15°10′																				
15–80/B1	0.6								0.60		0.0								0.00	
15–80/B2	0.5								0.46		0.0								0.00	
15–80/C2	0.0								0.00		0.0								0.00	
15–80/D3		1.3							1.25	0.60		0.0							0.00	0.00
15°40′																				
15–80/D4		0.4							0.40			0.0							0.00	
15–80/E4		0.3							0.33			0.0							0.00	
15–80/F4		0.0							0.00	0.29		0.0							0.00	0.00
All Latds./Areas	0.2	0.1	0.1	0.1	0.3	0.0	0.02	0.0	0.10	0.10	0.0	0.03	0.1	0.04	0.04	0.0	0.0	0.0	0.02	0.02

Table III A. (Continued)

Latitude/Areas	K. OTHERS 1973	1974	1975	1976	1977	1978	1979	1980	All years Area	All years Lat.	L. ALL FISH 1973	1974	1975	1976	1977	1978	1979	1980	All years Area	All years Lat.
11°40′																				
11–79/F5	44.4	22.2		67.8					42.39		50.0	31.5		258.5					114.04	
11–79/F6	34.1			77.4					63.46	50.62	36.6			386.7					273.97	176.53
12°10′																				
12–80/A1	4.9								4.89		44.4								44.44	
12–80/A2	15.0		58.6						37.95		35.0		116.9						78.11	
12–80/B2	13.9		52.2						27.88		64.5		155.7						97.78	
12–80/B3	264.6	303.0	40.1						180.19		319.7	326.0	131.8						241.58	
12–80/C3	281.2								281.18	128.24	321.8								321.82	183.15
12°40′																				
12–80/B4	100.6	367.8	50.2	6.2		93.9			60.69		437.4	375.4	145.5	83.4		164.4			160.34	
12–80/C4	87.7								87.71		164.1								164.07	
12–80/B5			24.3			69.5			31.82				80.7			127.5			88.50	
12–80/C5	0.1							1.2	0.30		32.9							29.2	32.24	
12–80/B6	20.4								20.44		50.4								50.44	
12–80/C6	60.4	13.9		36.9		45.6	15.4	2.9	31.94	35.66	96.8	75.1		65.6		54.8	50.3	39.4	66.66	78.93
13°10′																				
13–80/B1	20.8		36.8				4.7		10.47		63.0		73.5				53.4		56.97	
13–80/C1	44.0	16.3	19.1	23.6	3.5	30.7	19.2	2.9	18.81		110.8	71.7	63.8	54.1	77.9	70.2	67.4	34.1	68.86	
13–80/B2	24.5								24.46		50.6								50.58	
13–80/C2	0.5	16.1	16.3	16.2			14.3	5.6	10.18		17.2	54.5	53.9	78.6			46.2	33.1	41.76	
13–80/C3		25.7		6.8			22.7	10.0	16.35	17.39		58.3		51.4			73.7	45.6	56.24	64.38
13°40′																				
13–80/C4	127.2	71.0	65.8	106.0			20.1	16.3	46.62		225.2	103.8	124.5	156.7			69.8	100.5	107.17	
13–80/B5	123.8		48.2	21.6		78.8			46.60		205.6		137.3	58.9		100.5			119.00	
13–80/C5		192.5	52.7	57.2		123.6		10.7	67.76			253.2	138.9	145.3		163.3		106.3	149.98	
13–80/B6			57.4	38.6					54.49				124.5	129.0					125.18	
13–80/C6		459.6	80.9	93.9					141.72	81.25		524.3	153.1	338.2					317.68	185.24
14°10′																				
14–80/A1								2.4	2.40									64.0	64.00	
14–80/B1			30.7					37.0	33.37				106.3					186.0	139.84	
14–80/B2	96.6	92.9	208.6	85.6	22.6	102.0		33.5	77.20		126.6	121.8	412.4	179.6	176.2	142.1		146.5	189.45	
14–80/B3	181.2	109.0	148.3		21.3	226.3		39.3	79.74	76.92	200.8	127.8	261.9		171.0	230.7		157.5	183.36	185.01
14°40′																				
14–80/B4	95.2	90.4	43.3	20.8	18.5			24.9	37.47		109.0	121.4	140.4	51.4	167.6			92.4	129.54	
14–80/C4	72.2								72.17		82.0								82.00	
14–80/A5		30.1							30.10			73.1							73.10	
14–80/B5		213.0	18.8						191.71			246.6	167.5						237.96	
14–80/A6		75.7							75.72			276.3							276.29	
14–80/B6	148.5	215.3	10.3						146.76	90.22	260.2	242.0	114.1						219.43	168.21
15°10′																				
15–80/B1	166.4								166.36		225.6								225.64	
15–80/B2	168.5								168.46		244.0								244.04	
15–80/C2	228.6								228.57		357.1								357.14	
15–80/D3		384.1							384.13	195.50		442.3							442.25	263.83
15°40′																				
15–80/D4		91.7							91.70			118.9							118.90	
15–80/E4		140.4							140.43			155.9							155.92	
15–80/F4		219.2							219.18	139.89		246.3							246.33	162.07
All Latds./Areas	81.9	29.7	59.3	53.1	15.2	54.1	16.1	8.8	49.99	49.99	130.4	126.0	142.2	146.3	140.4	88.6	59.2	55.5	117.14	117.14

Table III A. (Continued)

M. EFFORT

Latitude	Areas	1973	1974	1975	1976	1977	1978	1979	1980	All years Area	All years Lat.
11°40′											
	11–79/F5	4.50	10.50		8.00					23.00	
	11–79/F6	4.75			10.00					14.75	37.75
12°10′											
	12–80/A1	4.50								4.50	
	12–80/A2	9.00		10.00						19.00	
	12–80/B2	10.00		5.75						15.75	
	12–80/B3	12.00	12.00	17.75						41.75	
	12–80/C3	11.00								11.00	92.00
12°40′											
	12–80/B4	6.50	5.00	30.00	32.00		8.00			81.50	
	12–80/C4	14.00								14.00	
	12–80/B5			10.00			2.00			12.00	
	12–80/C5	10.87							2.50	13.37	
	12–80/B6	4.50								4.50	
	12–80/C6	215.00	20.00		30.17		39.41	139.42	142.25	586.25	711.62
13°10′											
	13–80/B1	19.00		4.00				52.08		75.08	
	13–80/C1	114.00	389.45	143.00	169.65	175.05	150.23	173.73	120.49	1435.60	
	13–80/B2	21.50								21.50	
	13–80/C2	20.30	53.40	19.00	6.00			32.50	88.67	219.87	
	13–80/C3		17.16		10.00			18.08	28.50	73.74	1825.79
13°40′											
	13–80/C4	2.50	8.00	6.00	10.25			20.00	19.50	66.25	
	13–80/B5	7.05		75.00	31.75		4.00			117.80	
	13–80/C5		11.00	53.50	77.50		12.50		7.83	162.33	
	13–80/B6			43.75	8.00					51.75	
	13–80/C6		23.00	41.50	100.17					164.67	562.80
14°10′											
	14–80/A1								2.50	2.50	
	14–80/B1			11.00					8.00	19.00	
	14–80/B2	16.83	31.50	36.50	133.50	117.50	25.00		21.50	382.33	
	14–80/B3	44.00	42.00	47.75		156.00	7.75		24.25	321.75	725.58
14°40′											
	14–80/B4	12.00	20.00	33.50	27.75	70.00			12.00	175.25	
	14–80/C4	6.00								6.00	
	14–80/A5		10.00							10.00	
	14–80/B5		65.00	8.00						73.00	
	14–80/A6		7.00							7.00	
	14–80/B6	15.80	20.50	10.50						46.80	318.05
15°10′											
	15–80/B1	33.50								33.50	
	15–80/B2	24.00								24.00	
	15–80/C2	3.50								3.50	
	15–80/D3		8.00							8.00	69.00
15°40′											
	15–80/D4		10.00							10.00	
	15–80/E4		12.00							12.00	
	15–80/F4		6.00							6.00	28.00
All Latds./Areas		646.60	781.51	606.50	654.74	518.55	248.89	435.81	477.99	4370.59	4370.59

Table III B. *Areas of abundance in terms of annual catch-rate (kg/hr) in respect of major categories of fishes as obtained from the exploratory surveys of* M. V. *Meena Gaveshak during the years from* 1973 *to* 1980 *(Base: Madras)*

Latitude	Areas	A. SILVER BELLIES 1973	1974	1975	1976	1977	1978	1979	1980	All years Area	All years Lat.	B. PERCHES 1973	1974	1975	1976	1977	1978	1979	1980	All years Area	All years Lat.
10°40′																					
	10–79/F6					9.0				8.98	8.98					0.0				0.00	0.00
11°10′																					
	11–79/F1					10.9				10.93						0.0				0.00	
	11–79/F2				42.8	11.1				34.04					3.3	0.0				2.42	
	11–79/F3				63.8					63.81					6.6					6.63	
	11–80/A3		0.0							0.00	38.11		0.0							0.00	3.32
11°40′																					
	11–79/F4		8.0		0.0					4.56			34.4		2.0					20.35	
	11–80/A4		0.0							0.00			0.0							0.00	
	11–79/F5	12.1	0.0		0.0					9.14		0.0	49.5		0.0					10.70	
	11–80/A5		0.0							0.00			105.0							105.03	
	11–79/F6	25.2	0.0		0.0	5.0				13.11		0.0	28.3		0.0	16.0				10.85	
	11–80/A6	0.0	0.0							0.00	7.68	0.0	0.0							0.00	16.81
12°10′																					
	12–80/A1	0.0		50.8		27.7	0.0			22.90		0.0		15.3		4.7	0.0			6.61	
	12–80/B1			1.5			0.0			0.86				15.0			5.3			10.85	
	12–80/A2	0.0		3.4	0.0	12.7				4.53		0.0		24.8	0.0	14.5				19.72	
	12–80/B2	0.0		10.2		18.0	0.0			5.14		0.0		51.2		13.5	1.9			19.85	
	12–80/C2	0.0		110.3			0.0			16.14		0.0		3.8			5.1			2.38	
	12–80/B3	148.2		16.6	52.4	30.0				55.25		0.0		99.5	5.7	2.5				36.44	
	12–80/C3	108.0								108.00	21.89	0.0								0.00	18.37
12°40′																					
	12–80/B4	272.0			32.8	120.0	16.7			38.11		0.0			9.0	0.0	0.0			7.34	
	12–80/C4	37.6		32.0	165.9		0.0			97.50		0.0		8.0	0.8		0.0			0.67	
	12–80/B5	3.3			13.4					12.16		0.0			7.3					6.46	
	12–80/C5	12.5		13.9	11.1				20.5	12.84		0.0		13.3	2.6				0.0	4.59	
	12–80/B6	9.0		13.0	0.0					7.95		0.0		0.9	1.6					0.97	
	12–80/C6	28.6	53.7	50.4	20.8	0.0	10.3	29.5	21.0	31.88	32.91	0.0	0.08	5.3	1.0	0.0	0.1	0.01	0.1	0.79	1.57
13°10′																					
	13–80/B1	16.1		9.3						10.94		0.0		0.0						0.00	
	13–80/C1	9.5	35.4	40.9	90.2	38.0	26.6	13.1	19.5	33.82		0.0	0.04	0.8	5.4	0.1	0.02	0.1	0.8	0.84	
	13–80/D1	0.0								0.00		0.0								0.00	
	13–80/B2	17.5		37.6			0.0			29.15		0.0		28.7			0.0			19.60	
	13–80/C2	1.2	38.7	113.1		33.1		18.4	29.0	37.99		0.0	0.0	3.3		1.0		0.9	1.4	1.36	
	13–80/C3		28.21	139.2		36.4		12.9	30.2	35.75	33.69		0.0	63.2		0.0		1.5	5.8	8.46	2.14
13°40′																					
	13–80/B4					13.3	2.2	10.1	30.0	6.90						0.0	1.7	2.0	1.0	1.76	
	13–80/C4						8.7		24.0	16.10							4.2		4.8	4.50	
	13–80/B5			41.0		15.0	4.7			28.41				62.7		0.0	1.1			40.46	
	13–80/C5			45.7		139.3	11.3			44.08				63.2		0.0	1.4			49.46	
	13–80/B6	100.0		43.4						44.97		0.0		57.8						56.22	
	13–80/C6		31.0	62.6						52.57	31.84	0.0	0.0	50.5			0.0			39.70	28.20

Table III B. (Continued)

14°10′																				
14–80/A1								23.4	23.41									9.0	9.04	
14–80/B1	29.8	9.2	36.8		93.3			50.0	49.37		0.0	4.5	31.4		1.2			6.3	10.28	
14–80/A2	50.4								50.43		0.0								0.00	
14–80/B2	51.5	2.5	39.5		196.4	28.1		42.0	77.04		0.0	7.6	79.2		0.4	1.7		10.1	13.49	
14–80/B3	0.0	14.6	60.2		186.7	0.0		43.7	63.07		0.0	10.5	36.5		0.7	0.0		7.4	8.68	
14–80/C3								0.0	0.00	65.51								3.3	3.25	11.25
14°40′																				
14–80/B4		0.0	92.6						26.47			1.9	11.1						4.48	
14–80/C4								0.0	0.00									3.8	3.75	
14–80/A5		14.1							14.07			3.4							3.44	
14–80/B5		0.0	112.0						30.48			3.8	46.2						15.30	
14–80/C5								0.0	0.00									4.0	4.00	
14–80/A6		0.0							0.00			7.2							7.22	
14–80/B6		46.7							46.66	23.24		5.2							5.22	7.35
15°10′																				
15–80/B1	68.6								68.56		0.0								0.00	
15–80/B2	14.5								14.48		0.0								0.00	
15–80/C3		3.7							3.70	47.96		0.0							0.00	0.00
15°40′																				
15–80/C4		10.0							10.00			5.0							5.00	
15–80/D4		10.0							9.95			4.3							4.29	
15–80/E4		16.4							16.44			18.8							18.79	
15–80/F4		0.0							0.00	10.77		21.8							21.82	13.56
All Latds./Areas	27.7	25.4	44.6	51.2	99.5	13.0	16.1	26.6	36.75	36.75	0.0	6.4	33.0	4.0	0.9	1.5	0.3	3.3	8.22	8.22

Table III B. (Continued)

Latitude/Areas	C. RAYS & SKATES 1973	1974	1975	1976	1977	1978	1979	1980	All years Area	All years Lat.	D. JEW FISHES 1973	1974	1975	1976	1977	1978	1979	1980	All years Area	All years Lat.
10°40′																				
10–79/F6					5.2				5.18	5.18					1.7				1.73	1.73
11°10′																				
11–79/F1					13.5				13.47						0.8				0.80	
11–79/F2				5.7	10.6				7.09					0.0	0.4				0.10	
11–79/F3				6.1					6.07					0.0					0.00	
11–80/A3		0.0							0.00	6.83		0.0							0.00	0.14
11°40′																				
11–79/F4		2.6		2.7					2.61			0.0		0.0					0.00	
11–80/A4		0.0							0.00			0.0							0.00	
11–79/F5	10.3	0.0		5.0					7.91		1.7	0.0		0.0					1.28	
11–80/A5		0.0							0.00			0.0							0.00	
11–79/F6	18.3	0.0		0.0	0.0				9.40		9.6	0.0		0.0	0.0				4.91	
11–80/A6	28.4	0.0							26.45	8.07	2.9	0.0							2.75	1.73
12°10′																				
12–80/A1	14.0		1.0		20.3	9.8			8.05		2.4		0.0		0.0	0.0			0.58	
12–80/B1			0.0			19.3			8.29				0.0			0.0			0.00	
12–80/A2	0.0		3.6	30.0	18.2				7.50		0.0		0.0	0.0	0.0				0.00	
12–80/B2	9.3		2.1		21.3	15.6			10.00		7.0		0.0		0.0	0.0			1.46	
12–80/C2	0.0		0.0			51.1			18.37		2.8		0.0			0.0			1.39	
12–80/B3	0.0		4.7	28.9	20.0				15.61		11.1		0.0	0.0	0.0				1.83	
12–80/C3	0.6								0.63	11.05	14.3								14.25	1.52
12°40′																				
12–80/B4	0.0			9.0	30.0	0.0			8.01		20.0			2.5	0.0	0.0			2.54	
12–80/C4	10.7		0.0	10.2		19.4			12.27		6.7		0.0	0.0		0.0			1.20	
12–80/B5	3.5		0.0	0.0					0.42		0.0			19.6					17.24	
12–80/C5	15.4		0.0	2.0				2.5	4.46		0.0		0.0	0.0				0.0	0.00	
12–80/B6	0.0		0.0	0.0					0.00		0.0		0.0	0.0					0.00	
12–80/C6	7.4	2.0	2.9	0.4	0.0	0.0	0.3	1.0	2.12	2.94	7.8	0.0	0.0	1.4	0.0	0.0	0.0	0.2	1.46	1.99
13°10′																				
13–80/B1	1.8		2.0						1.98		0.0		0.0						0.00	
13–80/C1	11.5	1.8	2.6	5.0	2.0	0.5	1.1	1.4	2.04		0.0	0.0	0.0	2.7	0.1	0.0	0.4	5.9	1.16	
13–80/D1	0.0								0.00		0.0								0.00	
13–80/B2	8.9		5.3			0.0			5.42		1.5	0.0	0.0			0.0			0.31	
13–80/C2	0.3	1.2	1.7		0.0		0.8	7.2	4.85		0.0	0.0	0.0		0.0		0.0	8.0	4.96	
13–80/C3		0.0	7.1		17.3		8.7	4.4	5.49	2.72		0.0	0.0		0.0		23.1	8.2	8.87	2.07

Table III B (Continued)

13°40′																					
	13–80/B4					0.0	7.2	21.4	3.8	12.71						0.0	0.0	32.6	13.3	13.93	
	13–80/C4						10.2		18.8	14.37							0.0		29.0	14.02	
	13–80/B5			3.0		0.0	13.7			6.17				0.0		0.0	0.0			0.00	
	13–80/C5			3.2		16.3	15.2			5.93				0.0		0.0	0.0			0.00	
	13–80/B6	10.0		6.9						6.96		0.0		0.0						0.00	
	13–80/C6		4.1	14.7			12.7			13.37	10.94		0.0	0.0			0.0			0.00	5.64
14°10′																					
	14–80/A1								9.7	9.71									16.5	16.50	
	14–80/B1	22.1	17.0	11.1		23.0			12.3	18.31		9.9	0.0	0.0		0.9			60.8	4.78	
	14–80/A2	2.6								2.57		1.9								1.86	
	14–80/B2	8.8	5.6	4.5		16.2	11.9		23.2	13.31		5.6	0.0	0.0		1.7	0.0		60.5	12.84	
	14–80/B3	10.4	6.3	3.7		26.6	10.6		20.8	14.09		1.6	0.0			2.3	0.0		48.6	10.38	
	14–80/C3								4.5	4.50	14.17								58.5	58.50	10.96
14°40′																					
	14–80/B4		2.5	3.6						2.83			0.0	0.0						0.00	
	14–80/C4								27.3	27.25									58.8	58.75	
	14–80/A5		0.0							0.00			0.0							0.00	
	14–80/B5		2.2	16.2						5.97			0.0	0.0						0.00	
	14–80/C5								32.0	32.00									50.0	50.00	
	14–80/A6		12.8							12.84			0.0							0.00	
	14–80/B6		0.0							0.00	4.75		0.0							0.00	3.09
15°10′																					
	15–80/B1	2.1								2.06		6.2								6.18	
	15–80/B2	0.0								0.00		10.2								10.21	
	15–80/C3		0.0							0.00	1.30		0.0							0.00	6.93
15°40′																					
	15–80/C4		12.5							12.50			0.0							0.00	
	15–80/D4		10.8							10.83			0.0							0.00	
	15–80/E4		1.6							1.10			0.0							0.00	
	15–80/F4		0.0							0.00	5.16		0.0							0.00	0.00
All Latds./Areas		8.9	3.0	5.1	5.2	12.3	9.1	2.9	8.1	6.46	6.46	5.5	0.0	0.0	2.6	0.9	0.0	4.1	17.2	3.95	3.95

Table III B. (Continued)

Latitude/Areas		E. CARANGIDS 1973	1974	1975	1976	1977	1978	1979	1980	All years Area	All years Lat.	F. THREAD-FIN BREAMS 1973	1974	1975	1976	1977	1978	1979	1980	All years Area	All years Lat.
10°40′																					
	10–79/F6					2.2				2.16	2.16					0.0				0.00	0.00
11°10′																					
	11–79/F1					1.2				1.20						0.0				0.00	
	11–79/F2				4.5	0.8				3.49					0.2	0.0				0.14	
	11–79/F3				5.7					5.74					1.4					1.35	
	11–80/A3		5.8							5.83	4.20		11.7							11.67	1.61
11°40′																					
	11–79/F4		1.6		4.0					2.61			0.0		1.8					0.79	
	11–80/A4		7.0							7.00			13.0							13.00	
	11–79/F5	0.0	0.0		0.0					0.00		0.0	0.0		0.0					0.00	
	11–80/A5		2.7							2.74			12.6							12.57	
	11–79/F6	0.0	0.0		0.0	2.0				0.09		6.8	0.0		0.0	0.0				3.46	
	11–80/A6	0.0	0.0							0.00	0.77	0.9	0.0							0.81	2.04
12°10′																					
	12–80/A1	0.0		5.8		8.3	4.4			4.22		9.3		0.8		0.0	0.0			2.55	
	12–80/B1			3.5			6.3			4.69				2.2			0.0			1.26	
	12–80/A2	0.0		3.3	0.0	2.7				2.75		6.7		0.6	0.0	0.0				0.91	
	12–80/B2	0.0		4.2		2.4	4.1			3.13		12.5		0.8		0.0	0.0			2.89	
	12–80/C2	0.0		1.8			4.5			2.16		13.4		1.3			0.0			6.81	
	12–80/B3	0.0		6.8	12.8	2.5				8.28		5.0			0.4	0.0				1.01	
	12–80/C3	0.0								0.00	4.21	5.3								5.25	2.58
12°40′																					
	12–80/B4	0.0			5.6	15.0	0.0			4.94		0.0			1.3	0.0	0.0			1.04	
	12–80/C4	0.0		0.0	11.7		5.4			7.67		2.7		0.0	0.0		0.0			0.48	
	12–80/B5	0.0			0.3					0.24		1.8			0.7					0.86	
	12–80/C5	0.0		5.2	3.0				0.3	2.73		2.9		2.1	1.4				0.0	1.81	
	12–80/B6	0.0		0.0	0.0					0.00		0.7		3.6	0.5					4.36	
	12–80/C6	0.0	0.7	4.2	2.4	0.0	0.0	0.05	0.2	1.06	1.62	12.7	1.3	1.4	4.4	0.0	18.5	0.5	2.0	4.45	3.78
13°10′																					
	13–80/B1	0.0		4.0						3.04		7.5		0.6						2.26	
	13–80/C1	0.0	1.2	2.1	7.8	0.8	2.1	15.1	0.9	5.51		2.9	2.1	1.6	7.1	0.05	0.0	5.9	2.5	3.20	
	13–80/D1	0.0								0.00		7.5								7.50	
	13–80/B2	0.0		7.1			0.0			4.86		6.4		4.0			0.0			3.99	
	13–80/C2	0.0	1.6	9.3		0.0		1.8	1.4	2.28		2.5	0.9	5.7		0.0		14.2	4.0	4.27	
	13–80/C3		1.1	3.9		0.9		0.1	1.8	1.48	4.77		0.0	0.0		0.0		2.0	1.4	1.09	3.19

Table III B. (Continued)

13°40′																				
13–80/B4					0.0	3.6	0.3	0.8	2.04						0.0	0.0	4.2	0.0	1.71	
13–80/C4						4.2		5.4	4.78							0.0		4.0	1.91	
13–80/B5			8.2		0.0	8.6			7.93				1.4		0.0	0.0			0.90	
13–80/C5			6.4		4.3	3.6			5.80				1.4		0.0	0.0			1.11	
13–80/B6	0.0		4.6						4.50		0.0		2.1						2.06	
13–80/C6		1.5	4.7			4.2			4.29	4.61		1.0	0.5			0.0			0.50	1.31
14°10′																				
14–80/A1								1.2	1.18									0.0	0.00	
14–80/B1	0.0	6.2	9.9		4.4			9.0	5.15		0.9	0.0	2.1		0.0			12.5	2.01	
14–80/A2	0.0								0.00		0.4								0.43	
14–80/B2	0.0	7.4	11.7		5.6	6.0		8.1	7.08		3.9	2.3	2.9		0.0	0.0		9.4	2.76	
14–80/B3	0.0	8.9	8.7		3.4	6.7		7.0	6.41		4.7	1.2	3.1		0.0	0.0		9.0	2.85	
14–80/C3								0.3	0.25	6.22								0.0	0.00	2.51
14°40′																				
14–80/B4		5.9	5.1						5.62			1.7	1.5						1.65	
14–80/C4								0.3	0.25									0.0	0.00	
14–80/A5		4.6							4.58			0.0							0.00	
14–80/B5		3.5	8.7						4.93			0.8	0.0						0.60	
14–80/C5								0.4	0.40									0.0	0.00	
14–80/A6		1.3							1.28			0.0							0.00	
14–80/B6		2.7							2.71	4.41		0.0							0.00	0.64
15°10′																				
15–80/B1	0.0								0.00		3.9								3.86	
15–80/B2	0.0								0.00		3.6								3.59	
15–80/C3		0.0							0.00	0.00		0.6							0.57	3.55
15°40′																				
15–80/C4		6.5							6.50			3.3							3.25	
15–80/D4		10.2							10.24			2.2							3.24	
15–80/E4		12.2							12.22			3.9							3.89	
15–80/F4		7.3							7.27	9.83		9.7							9.70	4.47
All Latds./Areas	0.0	3.5	5.4	5.3	2.9	3.7	9.9	2.5	4.14	4.14	6.1	1.9	1.8	3.6	0.02	1.5	4.7	3.7	2.83	2.83

Table III B. (Continued)

Latitude/Areas	G. LIZARD FISHES 1973	1974	1975	1976	1977	1978	1979	1980	All years Area	All years Lat.	H. SHARKS 1973	1974	1975	1976	1977	1978	1979	1980	All years Area	All years Lat.
10°40′																				
10–79/F6					0.0				0.00	0.00					0.4				0.43	0.43
11°10′																				
11–79/F1					0.0				0.00						0.0				0.00	
11–79/F2					0.0				0.00					0.3	0.0				0.24	
11–79/F3				0.0					0.00					0.4					0.42	
11–80/A3		0.0							0.00	0.00		0.0							0.00	0.25
11°40′																				
11–79/F4		0.0		0.0					0.00			0.0		0.8					0.36	
11–80/A4		0.0							0.00			0.0							0.00	
11–79/F5	0.0	0.0		0.0					0.00		0.4	0.3		0.0					0.39	
11–80/A5		0.0							0.00			0.0							0.00	
11–79/F6	6.5	0.0		0.0	0.0				3.33		1.4	0.2		0.0	3.0				0.94	
11–80/A6	8.2	0.0							7.63	1.13	2.5	0.0							2.34	0.58
12°10′																				
12–80/A1	12.1		0.0		0.0	0.0			2.92		0.0		0.3		0.7	0.0			0.16	
12–80/B1			0.0			0.0			0.00				0.0			1.1			0.46	
12–80/A2	0.0		0.7	0.0	0.0				0.47		1.3		0.3	5.0	0.5				0.72	
12–80/B2	3.3		0.6		0.0	0.0			0.92		1.1		5.5		0.3	0.3			2.30	
12–80/C2	2.3		0.0			0.0			1.13		1.4		0.0			0.5			0.88	
12–80/B3	0.0		0.2	0.0	0.0				0.29		0.0		0.8	1.2	0.0				0.82	
12–80/C3	0.0								0.00	0.96	0.0								0.00	1.16
12°40′																				
12–80/B4	0.0			0.0	0.0	0.0			0.00		0.0			1.6	0.0	0.0			1.34	
12–80/C4	0.0		0.0	0.0		0.0			0.00		0.0		0.0	0.4		0.0			0.24	
12–80/B5	0.0			0.0					0.00		0.0		0.0	33.4					29.39	
12–80/C5	4.3		8.6	0.0				9.8	3.86		0.0		0.0	0.9				0.0	0.38	
12–80/B6	0.7		0.0	0.0					0.12		0.0		0.0	0.0					0.00	
12–80/C6	18.7	3.6	11.8	2.7	0.0	7.0	9.9	0.9	6.94	5.68	0.6	0.4	0.1	0.6	0.0	0.03	0.2	0.3	0.36	1.52
13°10′																				
13–80/B1	7.1		10.0						9.30		0.0		0.0						0.00	
13–80/C1	2.9	2.5	8.9	3.6	0.0	7.5	1.4	3.1	3.30		1.5	0.04	0.1	0.9	0.1	0.2	0.3	0.3	0.27	
13–80/D1	7.5								7.50		0.0								0.00	
13–80/B2	1.5		0.0			0.0			0.31		0.0		0.5			0.0			1.16	
13–80/C2	0.9	0.0	5.4		0.0		0.0	7.3	5.25		0.0	0.0	0.0		0.0		0.0	0.5	0.28	
13–80/C3		0.0	0.0		0.0		0.0	2.9	1.46	3.41		0.0	0.0		0.9		0.0	0.9	0.48	0.31

Table III B (Continued)

13°40′																				
13–80/B4					0.0	0.0	0.0	0.0	0.00						0.0	1.4	0.3	0.0	0.87	
13–80/C4						2.6		0.9	1.78							0.9		0.1	0.50	
13–80/B5			0.0		0.0	0.0			0.00				0.2		0.0	0.0			0.15	
13–80/C5			0.0		0.0	0.0			0.00				0.04		0.0	0.4			0.11	
13–80/B6	2.0		0.0						0.05		0.0		0.4						0.41	
13–80/C6		0.8	0.0			0.0			0.08	0.41		0.3	0.4			0.0			0.35	0.42
14°10′																				
14–80/A1								0.0	0.00									0.4	0.35	
14–80/B1	0.8	0.0	0.0		0.0			0.5	0.23		4.2	0.0	0.3		0.0			0.8	1.22	
14–80/A2	0.7								0.71		9.4								9.43	
14–80/B2	0.0	0.0	0.0		0.0	2.5		0.6	0.59		0.0	1.8	0.4		0.0	0.0		0.3	0.43	
14–80/B3	1.5	0.0	0.0		0.0	0.0		1.8	0.48		4.9	1.6	0.0		0.04	2.5		0.9	1.25	
14–80/C3								0.0	0.00	0.47								0.0	0.00	0.88
14°40′																				
14–80/B4		0.0	0.0						0.00			0.6	0.0						0.45	
14–80/C4								0.0	0.00									0.0	0.00	
14–80/A5		0.0							0.00			0.6							0.58	
14–80/B5		0.0	0.0						0.00			4.1	0.0						2.99	
14–80/C5								0.0	0.00									0.0	0.00	
14–80/A6		0.0							0.00			0.0							0.00	
14–80/B6		0.0							0.00	0.00		0.0							0.00	1.09
15°10′																				
15–80/B1	0.0								0.00		0.5								0.48	
15–80/B2	0.0								0.00		2.3								2.34	
15–80/C3		0.0							0.00	0.00		0.0							0.00	1.00
15°40′																				
15–80/C4		0.0							0.00			0.0							0.00	
15–80/D4		0.0							0.00			0.0							0.00	
15–80/E4		0.0							0.00			0.7							0.66	
15–80/F4		0.0							0.00	0.00		1.5							1.45	0.54
All Latds./Areas	5.9	1.4	3.4	1.8	0.0	2.9	2.8	2.6	2.59	2.59	1.2	0.6	0.5	3.0	0.1	0.4	0.2	0.4	0.77	0.77

Table III B. (Continued)

Latitude/Areas	I. PRAWNS										J. LOBSTERS									
	1973	1974	1975	1976	1977	1978	1979	1980	All years Area	Lat.	1973	1974	1975	1976	1977	1978	1979	1980	All years Area	Lat.
10°40′																				
10–79/F6					0.0				0.00	0.00					0.0				0.00	0.00
11°10′																				
11–79/F1					0.0				0.00						0.0				0.00	
11–79/F2				0.0	0.0				0.00					0.1	0.0				0.07	
11–79/F3				0.8					0.84					0.2					0.19	
11–80/A3		0.5							0.50	0.33		0.0							0.00	0.09
11°40′																				
11–79/F4		0.0		1.4					0.61			0.1		0.0					0.06	
11–80/A4		1.2							1.20			0.0							0.00	
11–79/F5	1.4	0.0		0.0					1.08		0.0	0.3		0.0					0.06	
11–80/A5		0.0							0.00			0.0							0.00	
11–79/F6	0.0	0.0		0.0	0.0				0.00		0.0	0.1		0.0	0.0				0.04	
11–80/A6	0.0	0.0							0.00	0.69	0.0	0.0							0.00	0.04
12°10′																				
12–80/A1	0.0		0.0		0.0	0.0			0.00		0.0		0.0		0.0	0.0			0.00	
12–80/B1			0.0			0.0			0.00				0.0			0.0			0.00	
12–80/A2	0.0		0.1	0.0	0.0				0.06		0.0		0.2	0.2					0.16	
12–80/B2	0.2		0.0		0.0	0.0			0.03		0.0		0.03		0.1	0.0			0.02	
12–80/C2	0.0		0.0			0.0			0.00		0.0		0.0			0.0			0.00	
12–80/B3	0.0		0.2	0.2	0.0				0.16		0.0		0.0	1.1	0.0				0.51	
12–80/C3	2.9								2.88	0.14	0.0								0.00	0.13
12°40′																				
12–80–B4	0.0			0.1	0.0	0.0			0.05		0.0			0.01	0.0	0.0			0.01	
12–80/C4	0.0		0.0	0.6		0.0			0.32		0.0		0.0	0.0		0.0			0.00	
12–80/B5	0.0			0.0					0.00		0.0			0.0					0.00	
12–80/C5	0.0		0.0	0.0				0.0	0.00		0.0		0.0	0.1				0.0	0.04	
12–80/B6	0.0		0.0	0.0					0.00		0.0		0.0	0.0					0.00	
12–80/C6	0.6	0.0	0.0	0.02	0.0	0.0	0.0	0.0	0.10	0.09	0.0	0.004	0.02	0.1	0.0	0.0	0.0	0.0	0.01	0.01
13°10′																				
13–80/B1	0.0		0.0						0.00		0.0		0.4						0.31	
13–80/C1	0.0	0.01	0.1	0.1	0.0	0.0	0.0	0.0	0.02		0.0	0.05	0.04	0.1	0.01	0.0	0.01	0.0	0.02	
13–80/D1	0.0								0.00		0.0								0.00	
13–80/B2	0.1		0.2			0.0			0.12		0.0		0.1			0.0			0.09	
13–80/C2	0.0	0.0	0.1		0.0		0.0	0.1	0.02		0.0	0.0	0.0		0.0		0.0	0.0	0.00	
13–80/C3		0.0	0.0		0.0		0.0	0.5	0.12	0.03		0.0	0.0		0.1		0.0	0.0	0.01	0.03

Table III B. (Continued)

13°40′																				
13–80/B4					0.0	0.0	1.9	0.0	0.78						0.0	0.0	0.0	0.0	0.00	
13–80/C4						0.0		0.0	0.00							0.0		0.0	0.00	
13–80/B5			0.0		0.0	0.0			0.00				0.0		0.5	0.0			0.02	
13–80/C5			0.2		0.0	0.0			0.05		0.0		0.01		0.0	0.0			0.01	
13–80/B6	0.0		0.1						0.18		0.0		0.0						0.00	
13–80/C6		0.0	0.4			0.0			0.14	0.20		0.0	0.01			0.0			0.01	0.01
14°10′																				
14–80/A1								0.2	0.20									0.0	0.00	
14–80/B1	1.2	0.07	0.0		0.0			0.0	0.33		0.0	0.07	0.0		0.2			0.0	0.08	
14–80/A2	0.0								0.00		0.0								0.00	
14–80/B2	1.0	0.2	0.0		0.2	0.0		0.0	0.12		0.0	0.07	0.0		0.0	0.0		0.0	0.01	
14–80/B3	0.0	0.07	0.0		0.5	0.0		0.0	0.14		0.0	0.0	0.2		0.0	0.0		0.0	0.02	
14–80/C3								0.0	0.00	0.17								0.0	0.00	0.02
14°40′																				
14–80/B4		0.0	0.0						0.00			0.0	0.0						0.00	
14–80/C4								0.0	0.00									0.0	0.00	
14–80/A5		0.0							0.00			0.0							0.00	
14–80/B5		0.0	0.5						0.13			0.0	0.0						0.00	
14–80/C5								0.0	0.00									0.0	0.00	
14–80/A6		0.5							0.48			0.0							0.00	
14–80/B6		0.0							0.00	0.06		0.0							0.00	0.00
15°10′																				
15–80/B1	0.2								0.18		0.0								0.00	
15–80/B2	0.0								0.00		0.0								0.00	
15–80/C3		0.0							0.00	0.11		0.0							0.00	0.00
15°40′																				
15–80/C4		0.0							0.00			0.0							0.00	
15–80/D4		0.0							0.00			0.0							0.00	
15–80/E4		0.2							0.22			0.0							0.00	
15–80/F4		0.0							0.00	0.09		0.0							0.00	0.00
All Latds./Areas	0.5	0.1	0.1	0.1	0.1	0.0	0.2	0.03	0.12	0.12	0.0	0.03	0.04	0.1	0.03	0.0	0.01	0.0	0.03	0.03

Table III B. (Continued)

Latitude/Areas	K. OTHERS 1973	1974	1975	1976	1977	1978	1979	1980	All years Area	All years Lat.	L. ALL FISH 1973	1974	1975	1976	1977	1978	1979	1980	All years Area	All years Lat.
10°40′																				
10–79/F6					14.2				14.25	14.25					32.7				32.73	32.73
11°10′																				
11–79/F1					5.9				5.87						32.3				32.27	
11–79/F2				62.4	2.6				45.82					119.3	25.5				93.43	
11–79/F3				61.4					61.38					146.4					146.43	
11–80/A3		94.8							94.83	50.96		112.9							112.83	105.84
11°40′																				
11–79/F4		19.1		63.8					38.28			65.8		76.5					70.23	
11–80/A4		103.0							103.00			124.2							124.20	
11–79/F5	156.5	0.2		10.0					118.66		182.4	50.3		15.0					149.22	
11–80/A5		53.5							53.49			173.8							173.83	
11–79/F6	57.7	0.1		7.5	2.0				30.33		125.4	28.8		7.5	28.0				76.46	
11–80/A6	31.6	0.0							29.50	82.51	74.5	0.0							69.48	122.05
12°10′																				
12–80/A1	78.4		53.1		21.3	61.0			58.81		116.2		127.1		83.0	75.1			106.80	
12–80/B1			3.5			33.1			16.16				25.7			65.1			42.57	
12–80/A2	27.6		24.5	2.5	5.1				19.98		35.6		61.4	37.5	54.0				56.80	
12–80/B2	104.4		50.3		5.6	47.4			56.78		137.8		124.8		61.6	69.4			102.52	
12–80/C2	47.6		6.3			45.3			40.68		67.5		125.3			106.4			89.94	
12–80/B3	219.0		72.0	21.7	0.0				70.47		383.3		201.4	124.4	55.5				190.67	
12–80/C3	105.3								105.24	52.55	236.3								236.25	114.56
12°40′																				
12–80/B4	408.0			22.4	3.0	16.8			30.03		700.0			84.3	168.0	33.5			93.41	
12–80/C4	89.1		82.4	16.3		63.2			43.06		146.7		122.4	205.9		88.0			163.41	
12–80/B5	1.0		0.0	48.6					42.91		9.5			123.3					109.68	
12–80/C5	0.6		90.9	39.2				4.0	41.38		35.8		134.0	60.3				37.0	72.11	
12–80/B6	0.0		18.4	25.5					17.39		10.3		35.9	34.6					30.79	
12–80/C6	110.7	28.8	28.4	37.9	8.3	26.2	8.4	2.6	34.83	35.39	187.1	90.6	104.5	71.7	8.3	62.1	48.8	28.1	84.00	87.50
13°10′																				
13–80/B1	3.1		2.4						2.54		35.6		28.7						30.39	
13–80/C1	1.9	28.9	29.3	68.8	3.0	13.8	15.1	6.0	22.33		30.0	72.1	86.3	191.7	44.2	50.7	52.5	40.3	72.51	
13–80/D1	25.0								25.00		40.0								40.00	
13–80/B2	13.5		79.2			36.9			61.09		49.5		163.9			36.9			126.10	
13–80/C2	4.9	10.3	28.8		5.9		25.4	8.2	11.65		9.8	52.7	167.1		40.0		61.5	66.9	72.91	
13–80/C3		15.3	229.6		3.6		17.3	10.7	30.78	22.77		44.5	443.0		59.2		65.6	66.5	93.95	75.13

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Table III B. (Continued)

13°40′																				
13–80/B4					0.0	96.0	20.7	16.8	59.81						13.3	112.1	93.5	65.5	100.51	
13–80/C4						91.6		28.0	60.78							122.4		114.8	118.74	
13–80/B5			54.8		0.0	139.3			78.40				171.2		15.5	167.5			162.46	
13–80/C5			70.9		30.3	77.7			70.20				191.0		190.0	109.5			176.77	
13–80/B6	105.0		45.6						47.25		212.0		161.1						162.60	
13–80/C6		0.0	73.4			59.2			64.03	63.61		38.7	207.0			76.1			175.04	147.19
14°10′																				
14–80/A1								11.8	11.76									72.2	72.17	
14–80/B1	185.5	128.3	91.0		11.2			45.0	95.16		254.6	165.2	185.2		134.1			197.0	186.94	
14–80/A2	67.1								67.14		132.5								132.57	
14–80/B2	127.1	154.0	83.8		33.6	79.8		48.8	75.21		197.9	181.5	222.2		254.1	130.0		202.2	202.88	
14–80/B3	349.8	157.9	57.6		25.9	242.0		52.9	114.02		372.9	200.9	170.1		246.1	260.0		192.1	221.39	
14–80/C3								8.5	8.50	86.64								75.0	75.00	198.78
14°40′																				
14–80/B4		175.4	61.4						142.80			188.0	175.2						184.30	
14–80/C4								4.8	4.75									94.8	94.75	
14–80/A5		78.4							78.40			101.1							101.07	
14–80/B5		65.7	123.4						81.40			297.6	306.9						141.80	
14–80/C5								8.8	8.80									95.2	95.20	
14–80/A6		161.2							161.15			183.0							182.99	
14–80/B6		144.6							144.57	103.46		199.2							199.16	148.07
15°10′																				
15–80/B1	113.9								113.90		195.2								195.22	
15–80/B2	140.4								140.41		171.0								171.03	
15–80/C3		20.0							20.00	115.04		24.4							24.29	175.89
15°40′																				
15–80/C4		153.4							153.38			190.6							190.63	
15–80/D4		90.2							90.23			127.8							127.80	
15–80/E4		183.6							183.56			236.9							236.88	
15–80/F4		184.8							184.85	157.03		225.1							225.09	201.45
All Latds./Areas	112.2	72.9	54.9	46.1	15.4	61.6	14.6	15.83	49.80	49.80	168.0	115.2	148.8	123.0	132.2	93.7	55.8	80.2	115.66	115.66

Table III B. (Continued)

M. EFFORT

Latitude/Areas	1973	1974	1975	1976	1977	1978	1979	1980	All years Area	All years Lat.
10°40′										
10–79/F6					11.58				11.58	11.58
11°10′										
11–79/F1					7.50				7.50	
11–79/F2				20.91	8.00				28.91	
11–79/F3				21.41					21.41	
11–80/A3		6.00							6.00	63.82
11°40′										
11–79/F4		9.33		7.08					16.41	
11–80/A4		5.00							5.00	
11–79/F5	54.75	15.66		2.00					72.41	
11–80/A5		8.75							8.75	
11–79/F6	12.00	8.41		2.00	1.00				23.41	
11–80/A6	9.17	0.66							9.83	135.81
12°10′										
12–80/A1	9.08		15.32		3.00	10.25			37.65	
12–80/B1			10.00			7.50			17.50	
12–80/A2	2.25		22.24	2.00	5.50				31.99	
12–80/B2	18.33		30.83		7.50	30.91			87.57	
12–80/C2	13.50		4.00			9.83			27.33	
12–80/B3	9.00		18.50	25.09	2.00				54.59	
12–80/C3	8.00								8.00	264.63
12°40′										
12–80/B4	1.00			35.34	1.00	6.00			43.34	
12–80/C4	7.50		1.25	22.50		10.33			41.58	
12–80/B5	4.00			29.58					33.58	
12–80/C5	12.00		14.00	24.67				4.00	54.67	
12–80/B6	3.00		8.00	5.50					16.50	
12–80/C6	102.50	129.73	74.15	122.42	4.00	33.14	80.33	135.77	682.04	871.71
13°10′										
13–80/B1	7.75		24.50						32.25	
13–80/C1	11.50	191.32	130.14	120.60	131.47	86.52	273.69	139.58	1084.82	
13–80/D1	2.00								2.00	
13–80/B2	11.00		37.66			6.50			55.16	
13–80/C2	10.25	14.58	19.99		7.00		9.50	100.66	161.98	
13–80/C3		16.08	8.50		5.50		21.00	50.41	101.49	1437.70
13°40′										
13–80/B4					1.50	44.48	34.50	4.00	84.48	
13–80/C4						52.31		49.08	101.39	
13–80/B5			26.25		2.00	12.75			41.00	
13–80/C5			66.47		4.00	14.83			85.30	
13–80/B6	1.00		35.91						36.91	
13–80/C6		12.00	87.81			11.82			111.63	460.71
14°10′										
14–80/A1								25.33	25.33	
14–80/B1	35.57	13.66	38.83		39.42			4.00	131.48	
14–80/A2	7.00								7.00	
14–80/B2	10.75	61.14	42.65		100.49	63.31		70.16	348.50	
14–80/B3	13.75	71.65	16.08		44.50	6.00		38.09	190.07	
14–80/C3								4.00	4.00	706.38
14°40′										
14–80/B4		23.75	9.50						33.25	
14–80/C4								4.00	4.00	
14–80/A5		29.07							29.07	
14–80/B5		23.16	8.66						31.82	
14–80/C5								2.50	2.50	
14–80/A6		6.23							6.23	
14–80/B6		9.58							9.58	116.45
15°10′										
15–80/B1	31.08								31.08	
15–80/B2	14.50								14.50	
15–80/C3		3.50							3.50	49.08
15°40′										
15–80/C4		8.00							8.00	
15–80/D4		10.25							10.25	
15–80/E4		18.25							18.25	
15–80/F4		8.25							8.25	44.75
All Latds./Areas	422.23	704.01	751.24	441.10	386.96	406.48	419.02	631.58	4162.62	4162.62

Table IV A. *Depth-wise annual catch rate (kg/hr) in respect of ten major categories of fishes as obtained from the exploratory surveys of* M. V. *Meena Sitara during the years from* 1973 *to* 1980 *(Base: Madras)*

A. SILVER BELLIES

Depth	1973	1974	1975	1976	1977	1978	1979	1980	All years
0–10				0.0		0.0			0.00
–20	21.4	9.8	24.6	18.6	127.3	0.0	11.4	35.3	42.85
–30	16.2	15.0	34.7	45.6	126.9	23.3	9.8	19.7	50.55
–40	16.7	46.2	40.0	59.6	146.5	6.2	21.7	27.9	40.67
–50	26.5	27.0	28.8	22.8	49.5	27.8	23.7	20.9	27.83
–60	11.0	49.7	14.3	10.6	94.4	23.8	19.0	28.2	31.88
–70		21.9							21.89
–80					115.0				115.00
All Depths	17.5	31.5	31.0	38.2	111.5	22.5	20.0	28.2	37.85

B. PERCHES

Depth	1973	1974	1975	1976	1977	1978	1979	1980	All years
0–10				2.4		0.0			2.08
–20		9.7	28.2	24.1	0.4	0.0	0.8	16.7	11.61
–30		7.6	38.2	41.5	2.1	5.7	0.7	4.8	20.95
–40		3.8	53.1	6.0	0.6	0.0	0.04	1.1	14.52
–50		3.2	19.8	0.0	0.2	0.6	0.06	0.7	3.56
–60		0.2	0.1	0.0	0.01	0.05	0.0	0.0	0.05
–70		11.7							11.68
–80					0.0				0.00
All Depths		3.7	32.1	24.9	1.0	1.0	0.1	2.8	9.32

C. RAYS & SKATES

Depth	1973	1974	1975	1976	1977	1978	1979	1980	All years
0–10				41.3		0.0			35.25
–20	8.7	2.2	3.3	2.9	6.3	0.6	9.0	13.2	6.14
–30	4.0	2.9	3.6	9.1	12.1	8.0	9.9	11.4	8.46
–40	8.0	0.3	6.4	11.5	3.2	7.6	0.5	1.6	4.84
–50	9.0		8.2	3.2	3.1	1.4	1.4	2.2	4.12
–60	8.8	2.5	3.2	0.9	1.7	3.3	1.3	2.3	3.45
–70		26.3							26.32
–80					2.1				2.10
All Depths	7.5	3.1	5.3	9.2	6.9	3.9	2.1	3.7	5.44

D. JEW FISHES

Depth	1973	1974	1975	1976	1977	1978	1979	1980	All years
0–10				0.0					0.00
–20	14.1			8.4	2.4		0.0	37.8	8.96
–30	13.5			22.6	1.6		1.4	13.4	9.96
–40	35.4			9.5	5.6		0.0	2.5	5.98
–50	11.0			0.8	0.8		4.4	3.5	2.48
–60	13.7			0.0	0.0		8.0	0.0	3.83
–70									
–80					1.5				1.50
All Depths	15.5			13.9	1.6		4.6	7.1	5.80

E. CARANGIDS

Depth	1973	1974	1975	1976	1977	1978	1979	1980	All years
0–10				7.1		0.0			6.00
–20		2.2	5.1	5.3	2.9	5.9	0.8	5.3	3.28
–30		5.3	5.6	5.8	4.3	4.5	0.1	4.5	4.41
–40			7.5	1.3	3.4	6.2	1.6	1.0	3.20
–50		2.7	6.7	2.2	0.5	0.5	6.7	0.4	2.73
–60			2.7	1.0	1.5	0.6	11.5	0.01	2.48
–70		4.7							4.74
–80					1.2				1.20
All Depths		2.6	5.9	4.4	2.9	1.6	7.0	1.2	3.21

F. THREAD-FIN BREAMS

Depth	1973	1974	1975	1976	1977	1978	1979	1980	All years
0–10				0.0		0.0			0.00
–20	2.7	0.9	0.0	0.8	0.0	0.0	16.6	2.4	1.81
–30	1.5	1.9	2.2	0.5	0.2	0.0	11.7	5.6	1.35
–40	0.9	0.8	1.6	2.9	0.0	0.0	4.2	2.9	2.11
–50	2.6		5.4	4.6	0.2	0.04	8.0	1.6	3.22
–60	3.7	1.2	4.5	2.3	0.03	0.04	6.8	0.4	2.60
–70		0.2							0.21
–80					0.0				0.00
All Depths	2.5	1.6	2.8	1.8	0.1	0.03	7.5	2.0	2.29

Table IV A. (Continued)

	G. LIZARD FISHES									H. SHARKS								
0–10				0.0		0.0			0.00				0.0		0.0			0.00
–20	0.8	0.4	0.0	1.3	0.0	0.0	0.0	0.0	0.42	1.7	0.2	0.3	0.3	2.5	0.0	0.4	0.2	0.94
–30	0.7	0.3	1.7	0.1	0.0	5.2	0.0	0.0	0.62	2.3	2.4	0.9	0.3	0.02	0.0	0.5	1.3	0.89
–40	2.5	1.5	1.8	0.0	0.0	0.0	0.6	1.7	1.30	0.5	2.0	0.6	0.5	0.4	0.0	0.7	0.3	0.61
–50	3.8	3.2	9.7	0.4	0.1	5.8	1.1	2.3	3.20	0.8	1.0	0.9	0.4	2.1	0.6	0.1	0.1	0.72
–60	8.7	3.8	16.3	0.8	0.0	5.8	2.3	1.3	4.88	1.1	0.7	0.3	0.3	0.7	0.4	0.5	0.3	0.60
–70		0.0							0.00		2.1							2.11
–80					0.0				0.00					0.0				0.00
All Depths	4.0	2.6	5.0	0.4	0.01	5.1	1.4	1.3	2.38	1.3	1.2	0.7	0.3	0.9	0.3	0.4	0.2	0.74

	I. PRAWNS									J. LOBSTERS								
0–10				0.0					0.00				0.0					0.00
–20	0.2	0.1	0.01	0.1	0.1		0.2		0.09		0.0	0.01	0.02	0.03				0.01
–30	0.2	0.2	0.2	0.2	0.3		0.1		0.20		0.0	0.01	0.03	0.02				0.02
–40	0.0	0.02	0.2	0.0	0.8		0.01		0.10		0.1	0.02	0.04	0.3				0.03
–50	0.1	0.1	0.04	0.02	0.1		0.01		0.05		0.04	0.2	0.1	0.1				0.05
–60	0.2	0.1	0.0	0.0	0.0		0.0		0.05		0.02	0.2	0.03	0.0				0.02
–70		0.0							0.00		0.0							0.00
–80					0.0				0.00					0.0				0.00
All Depths	0.2	0.1	0.1	0.1	0.3		0.02		0.10		0.03	0.1	0.04	0.04				0.02

	K. OTHERS									L. ALL FISH								
0–10				106.0		0.0			90.58				156.8		0.0			133.91
–20	130.8	109.8	66.1	36.5	23.2	153.7	14.1	35.1	64.17	180.3	135.3	127.6	102.0	165.1	165.1	53.3	146.1	140.28
–30	94.7	133.2	69.1	72.2	18.9	108.0	18.2	11.9	71.72	133.1	169.4	156.1	200.3	166.4	154.6	52.4	72.4	169.13
–40	26.6	84.8	86.7	26.6	13.9	110.5	15.8	7.6	42.08	90.5	146.0	197.9	174.7	131.4	141.4	45.1	49.5	115.44
–50	49.5	99.9	35.1	31.2	5.7	34.7	15.5	4.3	46.95	103.3	142.6	114.6	65.7	62.4	71.3	60.9	41.8	94.91
–60	91.8	11.1	17.0	13.3	3.8	35.9	16.7	1.8	29.60	139.1	84.9	58.8	29.3	102.1	69.8	66.1	28.1	79.44
–70		52.4							52.42		119.4							119.37
–80					50.0				50.0					169.8				169.8
All Depths	81.9	29.7	59.3	53.1	15.2	54.1	16.1	8.8	49.49	130.4	126.0	142.2	146.3	140.4	88.6	59.2	55.5	117.12

	M. EFFORT								
0–10				10.25		1.75			12.00
–20	85.88	58.23	78.50	80.50	101.50	9.00	24.75	59.42	497.78
–30	160.80	113.24	161.50	317.17	202.00	36.25	23.75	16.83	1031.54
–40	70.05	56.91	156.00	80.25	31.25	13.00	82.17	141.41	631.04
–50	134.37	330.63	139.75	100.92	63.30	49.73	132.15	169.58	1120.43
–60	195.50	213.00	70.75	65.65	110.50	139.16	172.99	90.75	1058.30
–70		9.50							9.50
–80					10.00				10.00
All depths	646.60	781.51	606.50	654.74	518.55	248.89	435.81	477.99	4370.59

Table IV B. *Depth-wise annual catch rate (kg/hr) in respect of ten major categories of fishes as obtained from the exploratory surveys of* M. V. *Meena Gaveshak during the years from* 1973 *to* 1980 *(Base: Madras)*

	A. SILVER BELLIES									B. PERCHES								
Depth	1973	1974	1975	1976	1977	1978	1979	1980	All years	1973	1974	1975	1976	1977	1978	1979	1980	All years
10–20	19.6	6.9	51.0	40.9	134.8	14.9	6.5	17.3	29.49		16.5	54.2	5.1	0.9	2.4	1.5	6.9	14.47
–30	63.7	18.5	47.1	91.0	122.9	8.3	21.7	42.0	56.24		3.7	35.6	7.2	1.4	1.9	0.6	6.5	12.01
–40	6.0	23.6	39.8	23.6	41.8	6.5	27.8	22.0	26.86		1.0	23.8	3.5	0.2	1.8	0.0	1.6	7.67
–50	38.0	49.7	38.3	51.1	27.8	15.3	16.7	26.6	33.34		0.9	16.1	1.3	0.0	0.2	0.3	1.7	2.63
–60	20.0	64.4		4.4	66.6	17.9	13.0	17.3	24.21		0.0		1.9	0.1	3.3	0.1	0.01	0.18
70–80		0.0							0.00		2.1							2.10
–90		16.4							16.39		3.0							3.01
–100	0.0	13.1							14.90		1.1							0.50
120–130		100.0							100.00		5.0							5.00
All Depths	27.7	25.4	44.6	51.2	99.5	13.0	16.1	26.6	36.75		6.4	33.0	4.0	0.9	1.5	0.3	3.3	8.22

	C. RAYS & SKATES									D. JEW FISHES								
10–20	10.0	4.8	7.8	8.9	14.4	12.1	22.3	14.2	9.79	5.8			0.0	1.0		30.6	24.8	4.99
–30	11.9	2.9	6.1	8.2	17.4	8.9	3.4	18.3	9.61	4.1			2.9	1.4		3.2	49.6	6.76
–40	2.0	0.8	3.5	4.2	7.2	11.8	0.0	4.7	3.85	1.9			5.1	0.0		0.0	7.4	2.43
–50	7.9	2.9	1.8	3.3	2.1	8.5	1.9	2.7	3.46	5.0			0.2	0.0		3.9	4.0	1.80
–60	8.4	2.1		0.0	1.0	3.3	0.6	2.5	2.91	8.1			0.0	0.0		0.4	0.4	1.81
70–80		0.0							0.00									0.00
–90		0.0							0.00									0.00
–100	21.8	0.0							12.00	0.0								0.00
120–130		0.0							0.00									0.00
All Depths	8.9	3.0	5.1	5.2	12.3	9.1	2.9	8.1	6.46	5.5			2.6	0.9		4.1	17.2	3.95

	E. CARANGIDS									F. THREAD-FIN BREAMS								
10–20		6.3	6.9	6.2	3.2	5.5	0.3	2.9	4.33	2.5	1.8	2.2	2.6	0.0	0.0	4.6	1.7	1.72
–30		4.3	6.7	8.4	4.3	4.2	0.2	6.3	5.16	2.8	2.1	1.9	5.7	0.02	0.0	0.0	6.6	2.38
–40		1.5	3.2	3.2	1.2	2.9	0.0	1.4	2.19	4.7	2.1	1.7	2.5	0.03	0.0	0.03	2.5	1.98
–50		0.9	4.0	4.5	0.3	2.2	14.5	1.1	3.78	5.1	1.9	1.2	3.2	0.0	0.0	6.7	2.8	2.81
–60		0.9		4.7	0.3	2.4	13.9	0.3	5.09	14.6	1.3		1.9	0.05	9.1	6.0	5.3	6.96
70–80		2.1							2.10		0.0							0.00
–90		2.2							2.19		0.0							0.00
–100		0.7							0.30	0.0	0.0							0.00
120–130		4.0							4.00		0.0							0.00
All Depths		3.5	5.4	5.3	2.9	3.7	9.9	2.5	4.14	6.1	1.9	1.8	3.6	0.02	1.5	4.7	3.7	2.83

Table IV B. (Continued)

G. LIZARD FISHES — H. SHARKS

10–20	0.5	0.0	0.1	0.0		2.4	0.0	0.5	0.49	1.2	1.2	0.3	0.3	0.1	0.8	0.2	0.2	0.73
–30	2.6	0.0	0.8	3.4		0.2	0.0	0.5	0.82	3.2	0.7	0.3	1.0	0.1	0.4	0.1	0.4	0.59
–40	3.8	3.5	7.1	0.9		0.0	4.9	3.3	3.64	0.6	0.0	1.0	7.0	0.1	0.5	1.2	0.5	1.86
–50	3.1	3.6	8.3	1.6		7.1	4.2	4.2	3.82	0.7	0.3	0.2	0.7	0.2	0.0	0.1	0.5	0.34
–60	18.4	1.0		0.0		7.1	3.0	3.7	6.42	0.6	0.6		0.8	0.2	0.4	0.2	0.3	0.37
70–80		0.0							0.00		0.0							0.00
–90		0.0							0.00		0.8							0.82
–100	0.0	0.0							0.00	0.0	0.9							0.40
120–130		0.0							0.00		0.0							0.00
All Depths	5.9	1.4	3.4	1.8		2.9	2.8	2.6	2.59	1.2	0.6	0.5	3.0	0.1	0.4	0.2	0.4	0.77

I. PRAWNS — J. LOBSTERS

10–20	0.8	0.1	0.1	0.3	0.02		1.9	0.1	0.27		0.04	0.02	0.04	0.02		0.0		0.02
–30	0.5	0.1	0.1	0.2	0.2		0.1	0.0	0.13		0.03	0.03	0.2	0.04		0.05		0.04
–40	0.0	0.04	0.1	0.03	0.0		0.0	0.01	0.03		0.04	0.1	0.1	0.08		0.0		0.06
–50	0.4	0.0	0.0	0.2	0.0		0.0	0.03	0.06		0.05	0.03	0.04	0.0		0.0		0.02
–60	0.6	0.0		0.0	0.0		0.0	0.0	0.12		0.01		0.2	0.01		0.0		0.03
70–80		0.0							0.00		0.0							0.00
–90		0.0							0.00		0.0							0.00
–100	0.0	0.0							0.00		0.0							0.00
120–130		0.0							0.00		0.0							0.00
All Depths	0.5	0.1	0.1	0.1	0.1		0.2	0.03	0.12		0.03	0.04	0.1	0.03		0.01		0.03

K. OTHERS — L. ALL FISH

10–20	152.7	113.5	68.9	33.5	11.3	94.1	20.6	17.5	85.95	192.9	151.1	191.5	97.8	165.7	132.2	88.5	86.1	152.25
–30	125.1	102.7	57.2	75.6	23.2	88.4	4.7	42.4	62.17	213.8	135.1	155.9	203.8	170.9	112.3	34.0	172.5	155.91
–40	31.4	24.2	48.1	30.9	10.1	35.0	6.4	7.7	28.55	50.2	56.7	128.3	81.0	60.8	58.4	40.3	51.1	79.12
–50	61.0	28.1	43.3	37.5	3.6	22.3	16.1	7.1	25.00	121.1	88.5	113.1	103.6	33.9	51.9	64.4	50.4	77.06
–60	116.2	33.0		27.4	2.0	30.2	17.8	2.1	37.32	186.9	103.2		41.3	70.3	72.8	55.0	32.0	85.42
70–80		105.9							105.90		110.1							110.10
–90		40.4							40.44		62.9							62.85
–100	46.4	47.3							46.80	68.2	83.1							74.90
120–130		36.5							36.50		145.5							145.50
All Depths	112.2	72.9	54.9	46.1	15.4	61.6	14.6	15.8	49.80	168.0	115.2	148.8	123.0	132.2	93.7	55.8	80.2	115.66

M. EFFORT

10–20	140.32	216.60	129.13	22.75	63.75	114.73	31.25	88.66	807.19
–30	68.83	170.41	317.34	132.50	198.16	101.27	62.77	139.00	1190.28
–40	45.50	110.31	205.20	150.93	38.42	39.40	33.33	134.91	758.00
–50	58.08	143.54	99.57	115.92	46.66	83.96	125.58	192.92	866.23
–60	104.00	47.74		19.00	39.97	67.12	166.09	76.09	520.01
70–80		5.25							5.25
–90		3.66							3.66
–100	5.50	4.50							10.00
120–130		2.00							2.00
All Depths	422.23	704.01	751.24	441.10	386.96	406.48	419.02	631.58	4162.62

Table V. *Latitude-wise estimated potential yields (in kg) in respect of ten major categories of fishes. (Figures in brackets are potential yields in kg. per sq. Km.)*

Categories	10°40′ off Velan-ganni	11°10′ off Poom-puhar	11°40′ off Porto-novo/ Cuddalore	12°10′ off Markka-anam	12°40′ off Maha-balipuram	13°10′ off Madras/ Ennore	13°10′ off Pulicat	14°10′ off Krishna-mpatnam	14°40′ off Iskapally	15°10′ off Ramaya-patnam	15°40′ off Nizam-patnam	All Latitudes
Silver Bellies	28754 (88.04)	488107 (373.63)	576737 (294.31)	499378 (218.43)	565402 (288.53)	609013 (310.78)	706224 (360.39)	1235124 (630.29)	938687 (410.59)	580515 (355.49)	84916 (65.00)	6312857 (333.26)
Perches	0 (0.00)	42522 (32.55)	270886 (138.24)	373189 (163.24)	24783 (12.65)	21709 (11.08)	605939 (309.22)	311615 (159.02)	202172 (88.43)	12167 (7.45)	189044 (144.71)	2054026 (108.43)
Rays & Skates	16586 (50.78)	87478 (66.96)	155807 (79.51)	207775 (90.88)	71660 (36.57)	55714 (28.43)	192502 (98.24)	215556 (110.00)	158913 (69.51)	53473 (32.75)	55330 (42.35)	1270794 (67.09)
Jew Fishes	5539 (16.96)	1793 (1.37)	30162 (15.39)	63431 (27.75)	61670 (31.47)	52064 (26.57)	168487 (85.98)	186162 (95.00)	65672 (28.73)	326280 (199.80)	0 (0.00)	961260 (50.75)
Carangids	6916 (21.18)	53793 (41.18)	19788 (10.10)	90327 (39.51)	26704 (13.63)	67241 (34.31)	105473 (53.82)	99709 (50.88)	106913 (46.76)	14729 (9.02)	88503 (67.75)	680096 (35.90)
Thread-fin Breams	0 (0.00)	20621 (15.78)	30739 (15.69)	53569 (23.43)	61478 (31.37)	61670 (31.47)	22670 (11.57)	38424 (19.61)	26224 (11.47)	26096 (15.98)	35222 (26.96)	376713 (19.89)
Lizard Fishes	0 (0.00)	0 (0.00)	16906 (8.63)	26672 (11.67)	89911 (45.88)	72044 (36.76)	7300 (3.73)	6148 (3.14)	7172 (3.14)	0 (0.00)	0 (0.00)	226153 (11.94)
Sharks	1377 (4.22)	3202 (2.45)	8837 (4.51)	27793 (12.16)	21901 (11.18)	7493 (3.82)	9414 (4.80)	17867 (9.12)	38327 (16.76)	24655 (15.10)	4227 (3.24)	165093 (8.72)
Prawns	0 (0.00)	4227 (3.24)	10374 (5.29)	4483 (1.96)	1152 (0.59)	576 (0.29)	2882 (1.47)	4034 (2.06)	2914 (1.27)	6244 (3.82)	2049 (1.57)	38935 (2.06)
Lobsters	0 (0.00)	1153 (0.88)	576 (0.29)	2241 (0.98)	192 (0.10)	576 (0.29)	192 (0.10)	576 (0.29)	672 (0.29)	0 (0.00)	0 (0.00)	6178 (0.33)
Others	45628 (139.71)	652688 (499.61)	1451833 (740.88)	1615581 (706.67)	682210 (348.14)	379624 (193.73)	1408607 (718.82)	1569793 (801.08)	2101511 (919.22)	2594389 (1588.73)	1926684 (1474.80)	14428548 (761.69)
All Fish	104800 (320.89)	1355584 (1037.65)	2572645 (1312.84)	2964439 (1296.68)	1607063 (820.11)	1327724 (677.53)	3229690 (1648.14)	3685008 (1880.49)	3649177 (1596.17)	3638548 (2228.14)	2385975 (1826.38)	26520653 (1400.06)
Area Explored in sq. km.	326.60	1306.40	1959.60	2286.20	1959.60	1959.60	1959.60	1959.60	2286.20	1633.00	1306.40	18942.80

Abalone transplantation in South America

In an effort to save an over exploited native species from extinction, scientists at the University of North in Antofagasta in Chile are studying the possibility of transplanting California red abalone to South America. If the animal from northern hemisphere *Haliotis rufescens* can be successfully acclimatized to its new home in the southern hemisphere and if the new species poses no threat to the region's indigenous species, it will be a great economic asset.

With financial assistance from the Organisation of American States preliminary experiments are being conducted at the University of North with 300 red abalone specimens. The scientists are particularly interested in the behaviour of the shell fish in relation to the native species of Chile, its utilisation of local algae species as food and the competition that the new comers could expect in this aspect from native inhabitants. These experiments are being carried out in a specially constructed laboratory with extreme care to prevent the escape of larvae or adult specimens into the natural environment, in order to rule out the possibility of the species reacting harmfully on the established inhabitants of the region.

International Exchange News 25 (2): 1981

Chile utilises the krill resources of the Antarctic

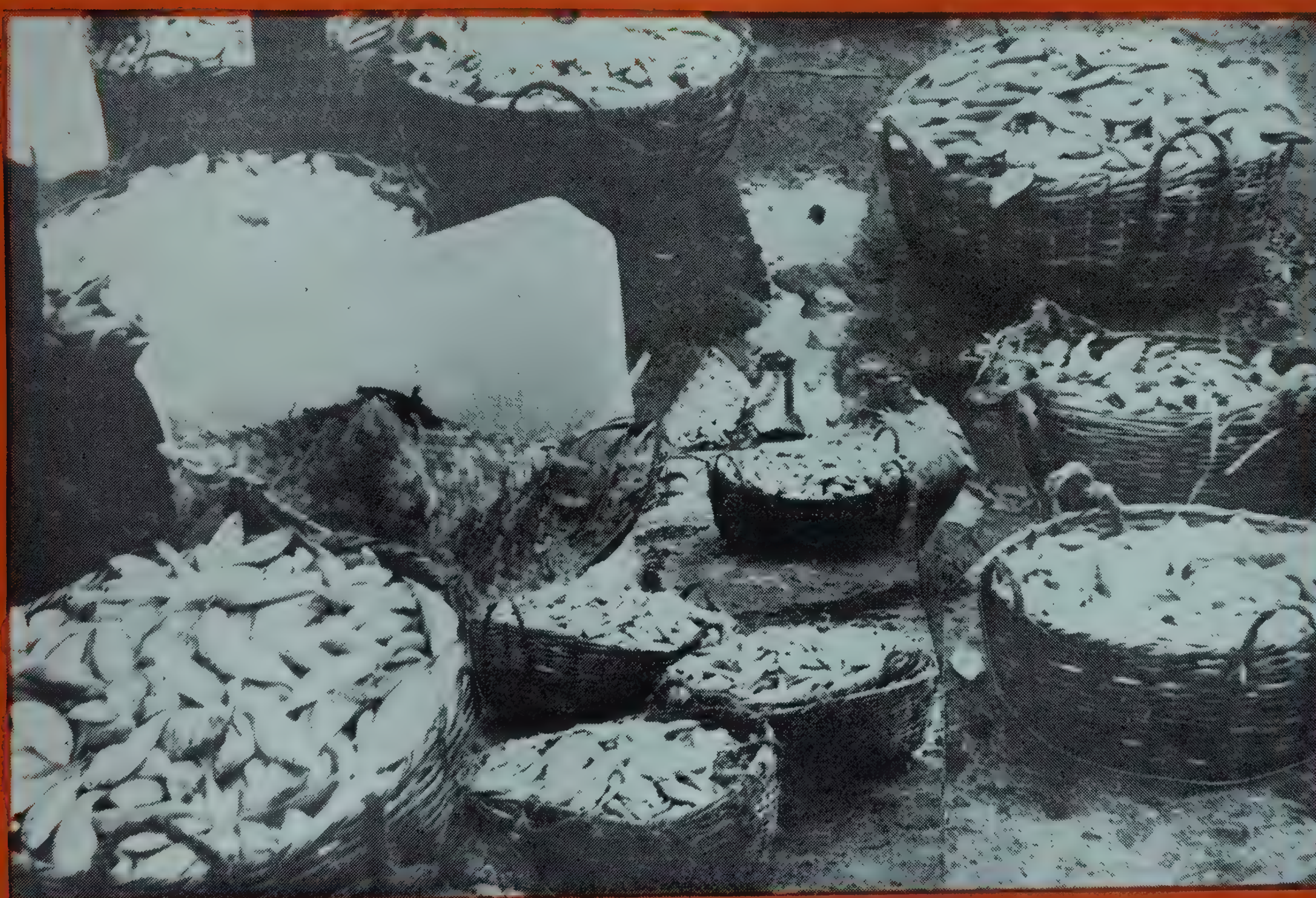
Taking advantage of its proximity to the krill resources of the Antarctic waters, Chile has embarked on a major effort to market krill products. The government's Institute of Fishing Promotion recently distributed nearly 20 tonnes of krill sticks to Santiago super markets where they were quickly accepted. The breaded, pre-cooked and frozen sticks require only 3 minutes of frying in cooking oil to make ready for the table. A box of 10 krill sticks weighing about ½ kg is sold for 80 U.S. cents. Private firms are now beginning to get involved in the commercial processing and marketing of the product.

According to a spokesman of the Institute, Chile is the first country to develop ready to cook products from krill without mixing them with other seafood ingredients. It could be made into soup, cheese, pudding, pate and salami. These tiny crustaceans contain all essential amino acids in addition to the two black eyes which are pure vitamin A.

International Exchange News 25 (2): 1981

Compiled and prepared by M. J. George, S. K. Dharmaraja & G. Subbaraju.
Published by Dr. M. J. George, Senior Scientist on behalf of the Director, Central Marine Fisheries Research Institute, Cochin-682 018 and printed at PAICO, Cochin-31

MARINE FISHERIES INFORMATION SERVICE



Technical and Extension Series

No. 33
NOV. DEC. 1981

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE

COCHIN, INDIA

INDIAN COUNCIL OF AGRICULTURAL RESEARCH

THE MARINE FISHERIES INFORMATION SERVICE: Technical and Extension Series envisages the rapid dissemination of information on marine and brackish water fishery resources and allied data available with the Fishery Data Centre and the Research Divisions of the Institute, results of proven researches for transfer of technology to the fish farmers and industry and of other relevant information needed for Research and Development efforts in the marine fisheries sector.

Abbreviation – *Mar. Fish. Infor. Serv. T & E Ser., No.* 33: 1981

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Cover photo : Baskets with catches from mechanised vessels, ready for transport to markets.

MANGALORE

PREFACE

Very few critical studies have been undertaken on the various inputs which have gone to strengthen the marine fisheries infrastructure in the country and assess their impact on the socio-economic structure of the fishermen communities. The rapid expansion of the fishing industry, chiefly through the introduction of mechanisation programmes resulting in a substantial increase in catch and export of marine products has brought about complex socio-economic problems in the coastal sector in many areas. The increasing pace of mechanisation in few centres has resulted in conflicts between the mechanised and traditional artisanal sectors in some of the maritime states. It has not been an easy task to find solutions to resolve such conflicts and adhoc arrangements are resorted to. In late 1978 it was felt that an impact analysis of the introduction of mechanisation through the co-operative sector and its working without impairment to the traditional artisanal sector should be investigated to assess how such a blending could take place. The working of the ARDC scheme of mechanisation programme at Puthiappa and Puthiangadi villages near Calicut in Kerala, an area of strong traditional non-mechanised fishing base offered scope for the study. The Project "Economics of marine fisheries in Calicut area" was thus taken as an inter-organisational programme by the Central Marine Fisheries Research Institute, Cochin and the Indian Agricultural Statistics Research Institute, New Delhi to be completed in two phases.

In the first phase of the project, results of which are embodied here, a survey of the socio-economic status of the fishermen of Puthiappa and Puthiangadi villages where the ARDC mechanisation programme has been in vogue is compared with the artisanal fishermen at adjacent Elathur Village where only traditional non-mechanised canoes operate. While the Project is in progress, it was felt desirable to bring out this interim report to stimulate initiation of such studies at different centres.

The scientists involved in this Project:

	CMFRI	IASRI
Project leaders	K. Alagaraja Scientist S2	R. K. Pande Scientist S3
Associates	K.K.P. Panikkar Scientist S1	B. Choudhary Scientist S1

I would like to express my appreciation to the collaborative effort put in by the team of Scientists from the two ICAR Institutes.

E. G. SILAS
Director

SOCIO-ECONOMIC STATUS OF FISHERMEN COMMUNITY OF CALICUT AREA*

Introduction

Marine fishery sector in India has undergone a rapid change after the introduction of mechanisation. Powering the boats for conveyance/fishing has improved the mobility and the efficiency of crafts. As during Industrial revolution the indigenous sector faced a set back with unbalanced economic change, mechanisation of marine fishing crafts has brought in both positive and adverse effects on the socio-economic conditions of rural fisherfolk; positive in the sense of increased catches and adverse in the sense that the presence of these mechanised boats deprive the legitimate claims of traditional crafts as they are not able to compete with the mechanised ones and hence catch less quantity of fish. Thus the economic viability of labour intensive traditional sector has faced a set back. This imbalance may be due to the presence of persons, other than fisherman, owning mechanised crafts, since fishermen are not able to purchase powered crafts due to their high costs.

In case the powered boats are made available to traditional fishermen they may get all the benefits of mechanisation which will improve their economy immensely. The main objective of this project is to study the impact of introduction of mechanised boats on the socio-economic conditions of traditional fishermen when they are supplied with mechanised boats. To study this impact, Calicut region is selected where Agricultural Refinance Development Corporation (ARDC) has supplied 50 mechanised boats of size 36′ so that each boat is allotted to seven fishermen families thus involving 350 fishermen families in this venture. These families belong to Puthiappa and Puthiangadi area. For comparative study another neighbouring village Elathur has also been selected where traditional fishing alone is followed.

Puthiappa and Puthiangadi are two marine fish landing centres where there are seven Fishermen Co-operative Societies. ARDC supplied 50 mechanised boats to these 7 co-operative societies. Each society is having about 50 members and each member representing a fishermen family in this region. In addition, under General Mechanisation Scheme (GMS) undertaken by the Kerala State Government there are eleven mechanised boats which also are brought under the ARDC Scheme. Apart from these 61 mechanised boats, there are 70 more mechanised boats owned by local fishermen. These 131 boats are engaged in trawl fishing in this area.

ARDC has introduced a slab system in sharing the catches as an incentive to the crew to bring better catches. The share rates introduced in 1976 are for catches worth upto Rs. 400, 401—500, 501—600 and 600 and above 30, 40, 45 and 50% respectively.

Under ARDC Scheme two nets for each mechanised boats are supplied @ Rs. 2,800 each. All ARDC boats are 36′, each costing Rs. 1.35 lakhs. Apart from these boats there are two workshops and three ice plants under this scheme to meet the local requirements. Mechanised boats operating gill nets numbering about 80 during season, owned by fishermen belonging to other areas such as Colachal are also fishing in nearby areas and landing their catches here. Also mechanised trawling boats of Elathur land their catches here because of the infrastructure facilities available here. In addition, about 275 indigenous boats are operating in this area. There are about 750 persons using boat seines, 200-300 persons using gill nets and 100 persons using hooks and lines. Each boat seine costs about Rs. 15,000, operation of which requires two boats and 15-20 men, 75% of the catches goes to the labourers and 25% to the owner. Fishermen community consists about 65% of local population. Total investment in this area is about Rs. 1 crore, ARDC investing 72 lakhs and NCDC 25 lakhs.

During October–May local fishermen operate both mechanised and indigenous boats and in the rest of the period mainly indigenous crafts. For operation of indigenous crafts at a considerable distance from the shore, mechanised boats are used for towing them 5–10 in number to the fishing grounds and back thus increasing the mobility of the indigenous crafts and improving the catches. This type of an integrated approach in the use of both mechanised and traditional crafts by the fishermen in fishing, hence, has made this area unique in all respects. Fisherfolk who do not go

* Prepared by K. K. P. Panikkar and K. Alagaraja

for fishing are otherwise engaged in net making under ARDC Project, operations of ice plants, workshops, sorting the catch, transporting and fish trading. Thus throughout the year almost all the fisherfolk are profitably engaged in one or the other type of activities connected with fisheries. Mechanised and traditional fishing are not competing with each other as in other areas in our coastal waters, but have become complementary to each other thus increasing the standard of life in this area. Availability of infrastructure facilities for processing the catch and amenities for quick disposal of the same are added attraction in this area.

In contrast to this, the landing centre at Elathur which is about 8 km from Calicut township consisting of three mechanised boats, 28 dug out canoes and 80 small boats, does not show much activity. No infrastructure facilities are available. Hence these mechanised boats land their catches at Puthiappa only. There is only one co-operative society consisting of about 180 members with a single mechanised boat. In this diluted responsibility the operation of this mechanised boat became a liability and was impounded by the Government for non-payment of loans.

In order to study the impact of introduction of mechanised crafts under the integrated approach for fishing, suitable schedules numbering five have been developed. The collection of data is planned in two phases. The first phase is concerned with the complete census of all the families in Puthiappa and Puthiangadi areas covered by the ARDC Scheme and families in wards I, II & III of Elathur village where there is a concentration of fishermen families. In this phase, data have been collected on size of the family, occupation details, possession of crafts, infrastructure facilities, indebtedness and income. In the second phase a sample of households representing all types of occupations will be selected for detailed study.

This report gives an account of the first phase of the project.

Work programme

Before initiation of the census, the following items of work were taken up.

1. Meeting the important personalities of the locality, Panchayat and Co-operative society Officials for enlisting their Co-operation.
2. Preparing a list of families residing in the area and obtaining a rough sketch of the area under coverage to form a base for the same and
3. Dividing the area into two exclusive parts to be given to two enumerators selected for collecting census data.

On 9–4–'79 two enumerators have been recruited and were given training at Calicut Research Centre of CMFRI, Calicut. The programme of work for the enumerators were chalked out in such a way that daily progress of work was brought to the notice of Officer-in-Charge, Calicut Research Centre and weekly reports were prepared, once in a week by enumerators. The Scientists from Headquarters and Officer-in-Charge, Calicut Research Centre supervised their work.

Size of the Family

In the Puthiappa-Puthiangadi area regarding the size of the family, there is wide variation between fishermen and non-fishermen families. As seen from Table 1, fishermen families are of large size when compared to non-fishermen families, the average sizes being 9.0 and 6.6 respectively. Of 858 fishermen families 204 (23.7%) families have more than 10 members whereas amongst 450 non-fishermen families only 51 (11.3%) families have more than 10 members. There are 39 fishermen families with more than 20 members and only one non-fishermen family under this classification. With 6 to 10 members there are 484 fishermen families and 227 non-fishermen families. However, among fishermen families only 170 families have less than 6 members constituting 19.8% and 172 non-fishermen families constituting 38.2%. Fishermen families are larger in size because of the joint family system still prevalent among the fishermen community in this area. The joint family system is convenient for them to do fishing as a joint venture. Financial difficulties in constructing a new house and lack of enough space for further partitioning compel them to stay together under one roof and maintain collateral joint system.

In Elathur village, of 473 fishermen families 73 (15.4%) families have more than 10 members. 349 families constituting 73.8% of the total fishermen families have more than 6 members, whereas out of 528 non-fishermen families 276 families constituting 52.3% come under this group. With the size of less than 6 members there are 124 (26.2%) fishermen families and 252 (47.7%) non-fishermen families. As in the case of Puthiappa-Puthiangadi, in this village also fishermen families are comparatively of larger size. Average sizes of fishermen and other families are 7.8 and 6.2 respectively. (Fig. 1).

Table 1. *Distribution of families of fishermen and others by size.*

Puthiappa–Puthiangadi

No. of Members / Category of families	1–5	6–10	11–20	above 20	Total
Fishermen families	170	484	165	39	858
Other families	172	227	50	1	450
TOTAL	342	711	215	40	1308
Elathur					
Fishermen families	124	276	69	4	473
Other families	252	233	42	1	528
TOTAL	376	509	111	5	1001

Occupational status

In Puthiappa-Puthiangadi area there are 858 fishermen families which constitute 65.6% of the total households (Table 2). Out of this 16 (1.9%) families have got full ownership and 273 (31.8%) families partial ownership of mechanised boats. The partial ownership comprises about 200 families who are shareholders in ARDC boats. In some families there are 2 or 3 shareholders and the total number of ARDC shares comes to 350. Initially it was proposed to provide one boat to seven families on the basis of only one member from each family. However, as it was a newly introduced scheme, the society found it difficult to get 350 families to take the shares in 50 boats. So some families were provided more than one share limited to a maximum of 3 shares. Only 69 (8.0%) families operate their own country crafts for fishing. Other than this, some of the families who own mechanised boats also have got country crafts. 467 (54.5%) families live on wages they receive from either mechanised boats or country crafts. They don't have any fishing equipments. For 33 (3.8%) families main occupation is any of the allied activities such as net repairing, fish trading, transporting fish etc. In this area there are 450 (34.4%) families who are not at all connected with fishing industry.

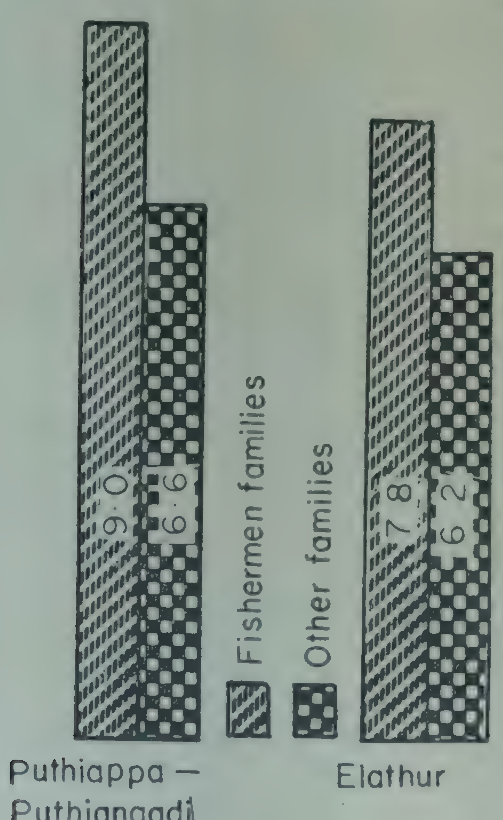

Fig. 1. Average size of the families of fishermen and others.

Those families who are share holders of ARDC boats are not actually the owners of the boats. They will get the ownership of the boats only after the complete repayment of the loan. Till that time the ownership is bestowed on the society. Each boat is allotted to 7 members on condition that they have to hand

Table 2. *Distribution of fishermen families by occupational status.*

Occupational Status	Puthiappa-Puthiangadi	Elathur
I. Fishing and allied activities		
1. Full ownership of mechanised boats*	16	1
2. Partial ownership of mechanised boats**	273	2
3. Ownership of country crafts***	69	73
4. Wage earners	467	351
5. Allied activities	33	46
TOTAL	858	473
II. Other activities	450	528
GRAND TOTAL	1308	1001

* Those families having full ownership of mechanised boats have been accounted here irrespective of their partial ownership of mechanised boats or ownership of country crafts.

** These families are having only partial ownership of mechanised boats. However they may have country crafts also.

*** They are owning only country crafts.

over to society certain percentage of their catch and from that the society will repay the ARDC loan. When the loan amount of a boat is fully repaid it will be released to its members. This arrangement is convenient both for the society and the fishermen. Since the society is regularly collecting its dues from the fishermen, it does not have any difficulty in the repayment of the loan. The advantage for the fishermen is that they are not directly responsible for the repayment of loan. The general complaint against the fishermen by the credit institutions such as banks, co-operative societies etc. is that once they have taken loan, they are not much bothered about repayment. Such a situation is successfully avoided in the above arrangement.

At Elathur out of 1001 families, 473 (47.3%) families are those of fishermen and out of them 351 (74.2%) are wage earners. They work in others boats or engaged in mussel collection. Only 3 families in this village have ownership of mechanised boats, one is fully owned by one family and the other two are partially owned. Even these three boats are operating mostly at Puthiappa area. Only 73 (15.4%) families operate their own country crafts. 46 (9.7%) families are engaged in mussel trading, transporting etc. In this village fishermen are mostly engaged in mussel collection and this is an important centre of mussel production.

Figure 2 shows the percentage distribution of families engaged in different fisheries activities in Puthiappa-Puthiangadi area and Elathur village.

Active fishermen

In Puthiappa-Puthiangadi 825 households are pursuing fishing as their full time occupation (Table 3). Of the 1658 active fishermen, belonging to these families, as many as 485 persons (29.3%) work in their own mechanised boats and 289 (17.4%) work in their own country crafts. 884 person constituting 53.3% of the total active fishermen, work in others boats (either mechanised or non-mechanised) for wages. 59 (3.4%) persons are engaged in allied fisheries activities other than fishing such as fish trade, net repairing, curing etc.

In Elathur village out of 756 active fishermen 5 are working in their own mechanised boats and 200 (26.5%) persons in their own country crafts (Table 3). Among the active fishermen 551 (72.9%) are wage earners without having any fishing equipment. 52 (6.9%) persons are engaged in allied fisheries activities.

The percentage distribution of active fishermen by their occupational status is illustrated in Figure 3.

Family Income

In spite of difficulties, such as one year recall period, non-maintenance of household accounts, illiteracy of

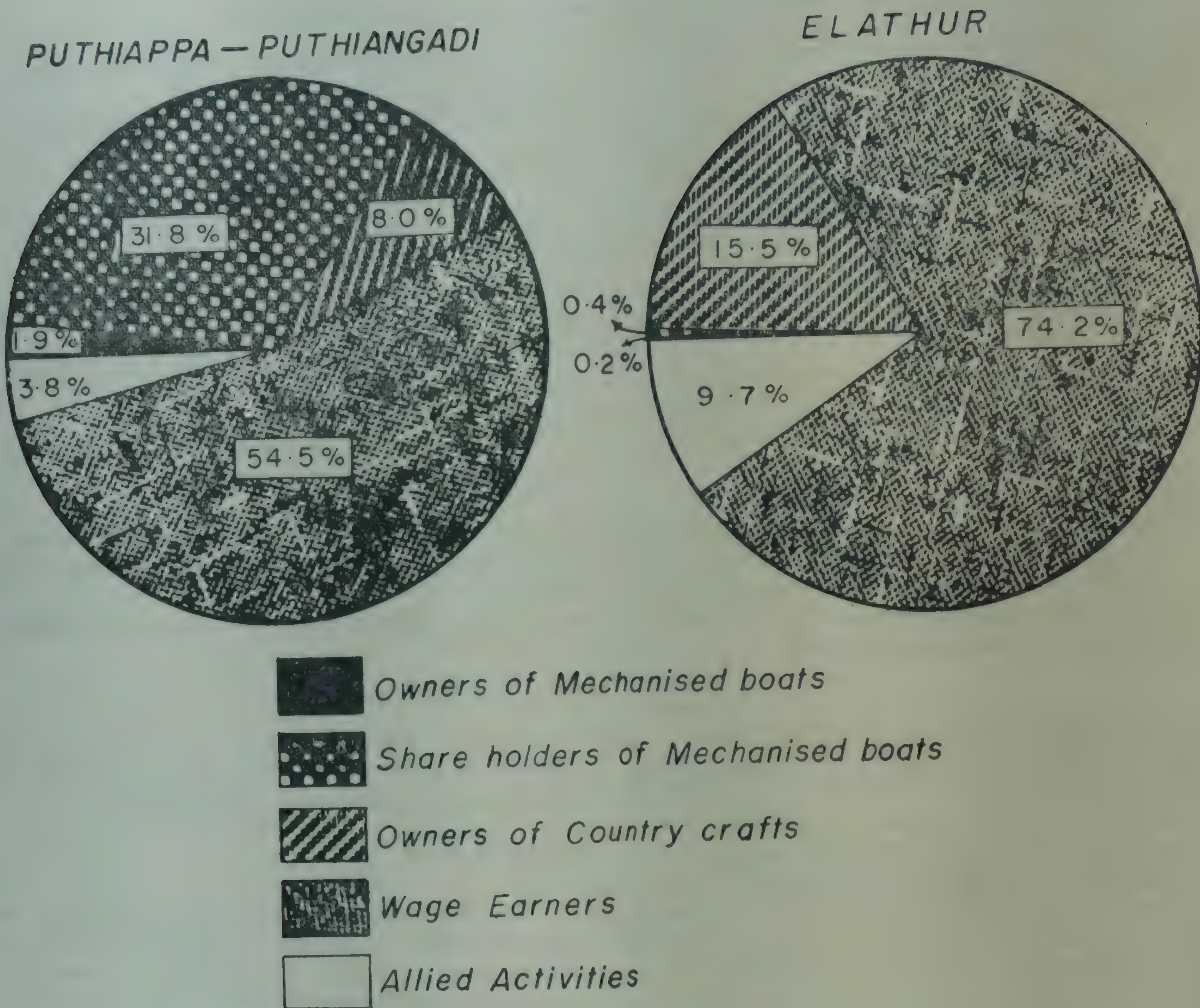

Fig. 2. Percentage distribution of families engaged in different fisheries activities.

the people and availability of free ration during off-seasons for only those whose annual income is below Rs. 1200/- etc., every effort has been made in convincing the local people about the scope and purpose of the enquiry while collecting the data.

Table 4 gives the distribution of the households in Puthiappa-Puthiangadi area by annual income groups and occupational status. The statement shows that the largest single group accounting for 44.9% of the total fishermen households have annual income between Rs. 1001 and 2000. They are followed by those in the income group of Rs. 501–1000 forming 22.1% and those in the income group of Rs. 2001–3000 constituting 19.8% of the total fishermen households. There are, however, 103 fishermen households (12% of the total fishermen households) in the annual income group of above Rs. 3000. Only 4 families have recorded an annual income in the range of Rs. 10,000–30,000. On the lower side only 10 families are found in the annual income group of Rs. 500 and below and 200 families (23.3%) in the group of less than Rs. 1001.

The analysis of the statement on the basis of the occupational status of the fishermen reveals that out of 16 families who have full ownership of the mechanised boats, 15 families have an annual income of more than Rs. 3000. Even among the 273 fishermen families who have got partial ownership of mechanised boats all have reported their annual incomes as above Rs. 1000. Among them, 133 families (constituting 48.7% of the total share holders of mechanised boats) are in the annual income group of Rs. 2001–3000 and 30 families in the income group of above Rs. 4000/-. Among

Table 3. *Distribution of active fishermen by their occupational status.*

Occupational Status	Puthiappa-Puthiangadi	Elathur
1. Number of fishermen operating:		
a) Own mechanised boats	45	2
b) Partially owned mechanised boats	440	3
c) Country crafts	289	200
d) Others boats (both mechanised & non-mechanised)	884	551
Active fishermen (a + b + c + d)	1658	756
2. Fishermen engaged in allied activities	59	52
3. Other activities	645	823
TOTAL	2362	1631

Table 4. *Distribution of households by occupational status and annual income groups* in Puthiappa–Puthiangadi

Type of activities	(Income range in Rs.) 500 & below	501–1000	1001–2000	2001–3000	3001–4000	4001–5000	5001–10000	10001–20000	20001–30000	Total
1. Owners of mechanised boats	—	—	—	1	5	5	2	2	1	16
2. Share holders of mechanised boats	—	—	62	133	48	15	14	1	—	273
3. Owners of country crafts	—	1	53	14	1	—	—	—	—	69
4. Wage earners	10	185	253	17	2	—	—	—	—	467
5. Allied activities	—	4	17	5	5	2	—	—	—	33
TOTAL	10	190	385	170	61	22	16	3	1	858
6. Other activities (excluding fishery activities).	30	63	173	71	34	17	48	13	1	450

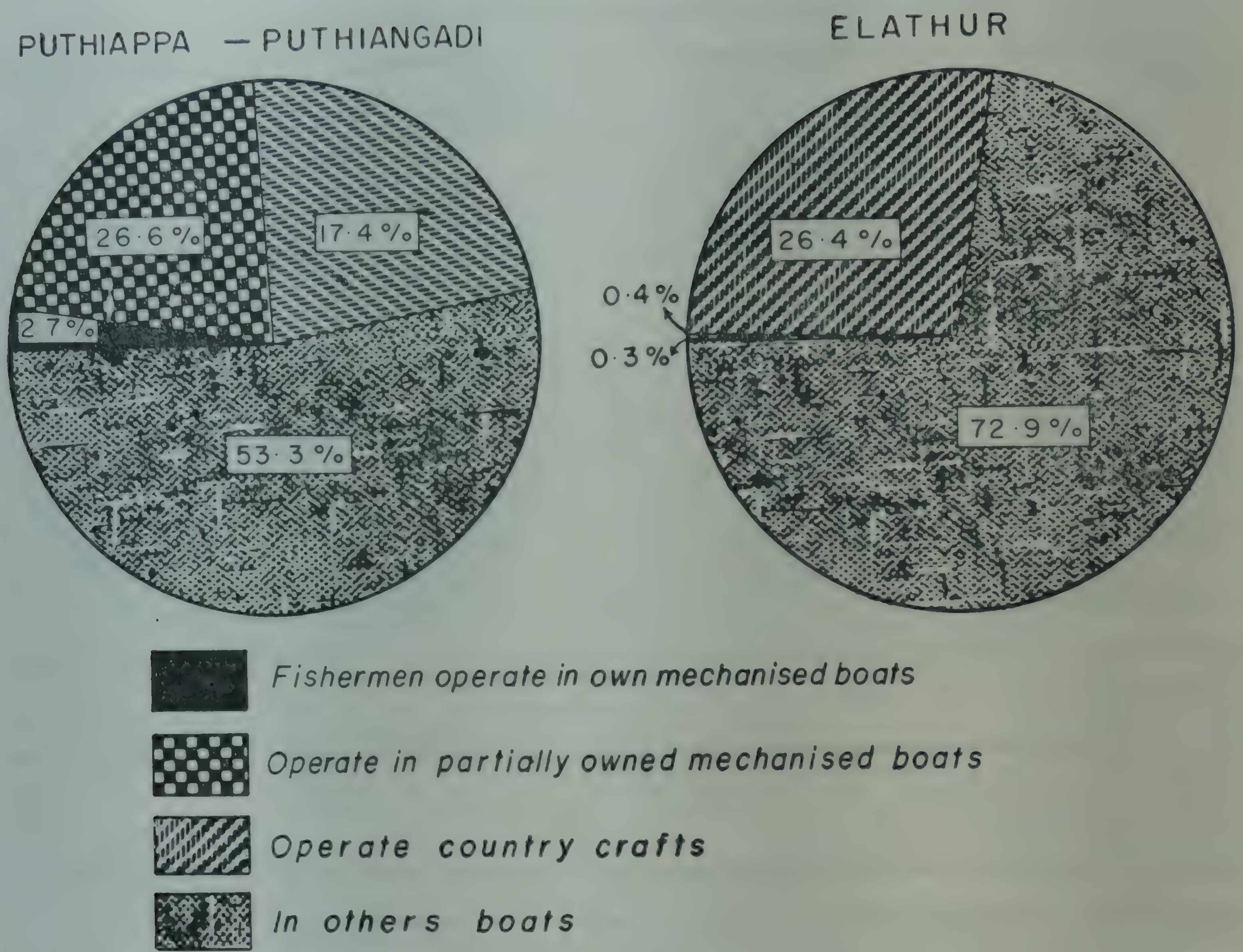

Fig. 3. Percentage distribution of active fishermen by their occupational status.

the 69 fishermen families who do fishing by only country crafts one family has an annual income of Rs. 1000/- or less. 53 families constituting 76.8 per cent of the country craft operators are in the income group of Rs. 1001–2000 and 15 families in the group of Rs. 2001–4000. Of the five different categories classified under the occupational status of the fishermen families, wage earners are found to be more in the lower income groups. Out of 467 families of wage earners 448 families (95.9%) have annual income of Rs. 2000 or less and 41.8% of them earn annually Rs. 1000/- or less. Of the 33 families engaged in allied activities such as fish trading, net making, repairing etc. 29 (87.8%) families have annual income of more than Rs. 1000, out of which 12 families are in the income range of Rs. 2001 to 5000. Only 4 families earn Rs. 1000/- or less.

The average annual income per fishermen household in this area is worked out at Rs. 2200.

From Table 5 it is seen that in Elathur village, of the 473 fishermen families 387 families (81.8%) have annual income between Rs. 501 and 2000. 169 families (35.7%) earn annually Rs. 1000/- or less 61 (12.9%) families have come under the income group of Rs. 2001–3000 and 25 (5.3%) families have reported their income between Rs. 3000 and 10,000.

As seen from the statement, in this village there is only one family which is having full ownership of a mechanised boat and this family comes under the annual income group of Rs. 2001–3000. Of the two families who are shareholders of mechanised boats one is in the annual income group of Rs. 2001–3000 and the other in Rs. 3001–4000. Out of 73 families who operate country crafts 50 (68.5%) are in the income group of Rs. 1001–3000. 14 (19.1%) families come under the income group of Rs. 3001–4000 and 9 families in the group of Rs. 4001–10,000. Of 46 families who are engaged in allied activities such as fish trading,

Table 5. *Distribution of house-holds by occupational status and annual income groups* in Elathur

Type of Activity	(Income range in Rs.)										
	500 & below	501–1000	1001–2000	2001–3000	3001–4000	4001–5000	5001–10000	10001–20000	20001–30000	Above 30,000	Total
1. Owners of mechanised boats	—	—	—	1	—	—	—	—	—	—	1
2. Share holders of mech. boats	—	—	—	1	1	—	—	—	—	—	2
3. Owners of country crafts	—	—	31	19	14	4	5	—	—	—	73
4. Wage earners	—	161	164	26	—	—	—	—	—	—	351
5. Allied activities	—	8	23	14	—	1	—	—	—	—	46
TOTAL	—	169	218	61	15	5	5	—	—	—	473
Other Activities	51	108	98	76	37	41	74	28	11	4	528

net making etc., half of them come under the income group of Rs. 1001–2000, 14 families are in the group of Rs. 2001–3000 and one family earns an annual income of Rs. 4001–5000. The average annual income of a fishermen household is worked out at Rs. 1125/-.

Indebtedness

Out of 858 fishermen families in Puthiappa-Puthiangadi area, 642 families (74.8%) are in debt. Table 6 gives the number of fishermen families in debt by source and annual income Since there are instances that the same family has taken loan from different sources, for the purpose of classification, the major source of loan has been taken into consideration for each family. Accordingly, the major contributor towards the loan requirement of fishermen families in this area is the co-operative society. This is because of the loan (Rs. 72 lakhs) advanced by the ARDC through the co-operative society. 223 families constituting 34.7% of the total fishermen families in debt have received loans through co-operative societies. For 196 families (30.5%) money lenders are the major contributors of their loan requirements. The rate of interest generally ranges from 24 to 75%. Out of them 63 (32.1%) families have taken loan on contract basis. Credit is advanced on contract basis only to those fishermen who own some fishing equipments. The size of the loan depends on the value of those equipments. No time will be fixed for the repayment of loan. Generally, to receive a loan the boat owner (both for mechanised and non-mechanised) has to enter into a contract with the money lender by which the borrower is bound to give the moneylender certain percentage of their daily catch. This often ranges from 15 to 30% depending upon the size of the loan till the repayment of the loan. Boat owners also advance loans to fishermen. There are 102 (15.9%) such families who have received loans from boat owners. With the receipt of this loans which generally ranges from Rs. 500 to 1500, they will become contract labourers and they should work only in that boat from the owner of which they have received loan till the loan is repaid. There is no interest in cash or kind.

Bank's contribution to the outstanding debt of the fishermen is only a meagre one. 53 families constituting 8.3% of the total fishermen families in debt, have received loans from banks. Size of the loan is also comparatively small.

In Elathur village (Table 7) out of 473 fishermen families only 43 families (9.1%) have taken loan. Of these, 19 families have received loans from banks (44.1%). 12 families are indebted to boat owners. 8 families received loan from money lenders. As compared to Puthiappa-Puthiangadi the percentage of fishermen in debt in Elathur village is far less. This is mainly because of the absence of loan facilities here. Most of the fishermen families do not possess any

Table 6. *Distribution of fishermen families in debt by source of credit and annual household income groups:* Puthiappa–Puthiangadi

		(Income groups in Rs.)							
Sources	500 & below	501–1000	1001–2000	2001–3000	3001–4000	4001–5000	5001–10000	10001–20000	Total
1. Government	—	2	3	8	2	—	1	2	18
2. Co-operative Society (including ARDC)	—	1	101	90	19	6	6	—	223
3. Money lenders	—	29	107	33	18	5	4	—	196
4. Boat owners	—	54	42	6	—	—	—	—	102
5. Banks	—	4	24	11	6	4	3	1	53
6. Others	1	17	22	5	3	2	—	—	50
TOTAL	1	107	299	153	48	17	14	3	642

Table 7. *Distribution of fishermen families in debt by source of credit and annual household income groups:* Elathur

		(Income groups in Rs.)							
Sources	500 & below	501–1000	1001–2000	2001–3000	3001–4000	4001–5000	5001–10000	10001–20000	Total
1. Government	—	—	—	2	—	—	—	—	2
2. Co-operative Society (including ARDC)	—	—	—	—	—	—	—	—	—
3. Money lenders	—	3	2	1	1	—	1	—	8
4. Boat owners	—	4	6	2	—	—	—	—	12
5. Banks	—	3	12	3	—	—	1	—	19
6. Others	—	—	1	—	1	—	—	—	2
TOTAL	—	10	21	8	2	—	2	—	43

Table 8. *Borrowings of fishermen from different agencies (in Rs.)*

Credit Agencies	Puthiappa & Puthiangadi	Elathur
Government and Co-operative Societies	3,57,000	5,000
Banks	3,14,400	18,500
Money lenders	6,52,900	17,000
Boat owners	73,350	8,400
Others	1,84,400	3,500
TOTAL	15,82,050*	52,400

* Excluding the loan advanced by ARDC.

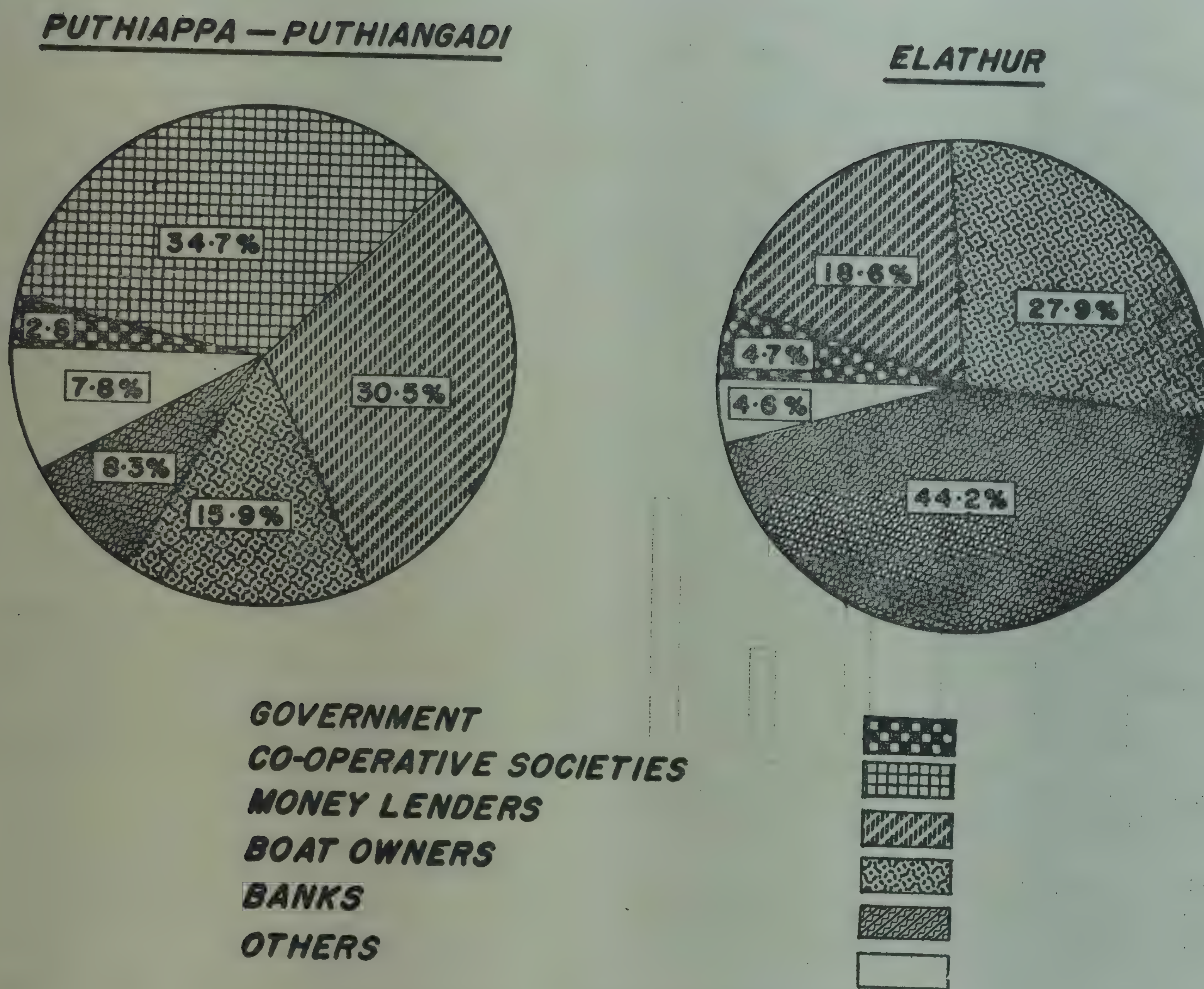

Fig. 4. Percentage distribution of families taken loan from different sources.

fishing equipment and their repaying capacity is very poor. Generally money lenders are not interested in giving loan to such families. Even the loans advanced to few families by banks and money lenders are of small amounts (Fig. 4).

The total outstanding debt of the fishermen families amounted to about Rs. 16 lakhs in Puthiappa-Puthiangadi and about Rs. 50 thousand in Elathur. This excludes the loan extended by ARDC and G.M.S. in Puthiappa-Puthiangadi, which amounted to about Rs. 1 crore.

As seen from the Table 8, even without taking into consideration the ARDC and G.M.S. loans, there are better credit facilities in Puthiappa-Puthiangadi than in Elathur. In Puthiappa-Puthiangadi the Government and Co-operative Society advanced a loan of Rs. 3.57 lakhs whereas in Elathur it was only Rs. 18.5 thousand. The contribution of money lenders amounted to Rs. 6.53 lakhs in Puthiappa-Puthiangadi and Rs. 17 thousand in Elathur (Fig. 5).

Income-effect of Mechanisation

As indicated earlier, the Agricultural Refinance Development Corporation advanced a loan of Rs. 72 lakhs to the Kozhikode Regional Fish Marketing Co-operative Society to introduce mechanised fishing in Puthiappa-Puthiangadi area.

From the records available in the Society during the period from 1971–72 to 1978–79, the total value of the entire catch by these boats worked out to Rs. 1,74,77,726. Out of this, an amount of Rs. 49,91,270 was paid to fishermen as wages. The commission paid to members amounted to Rs. 8,73,754. Oil expenditure and repairing charges came to Rs. 57,23,388

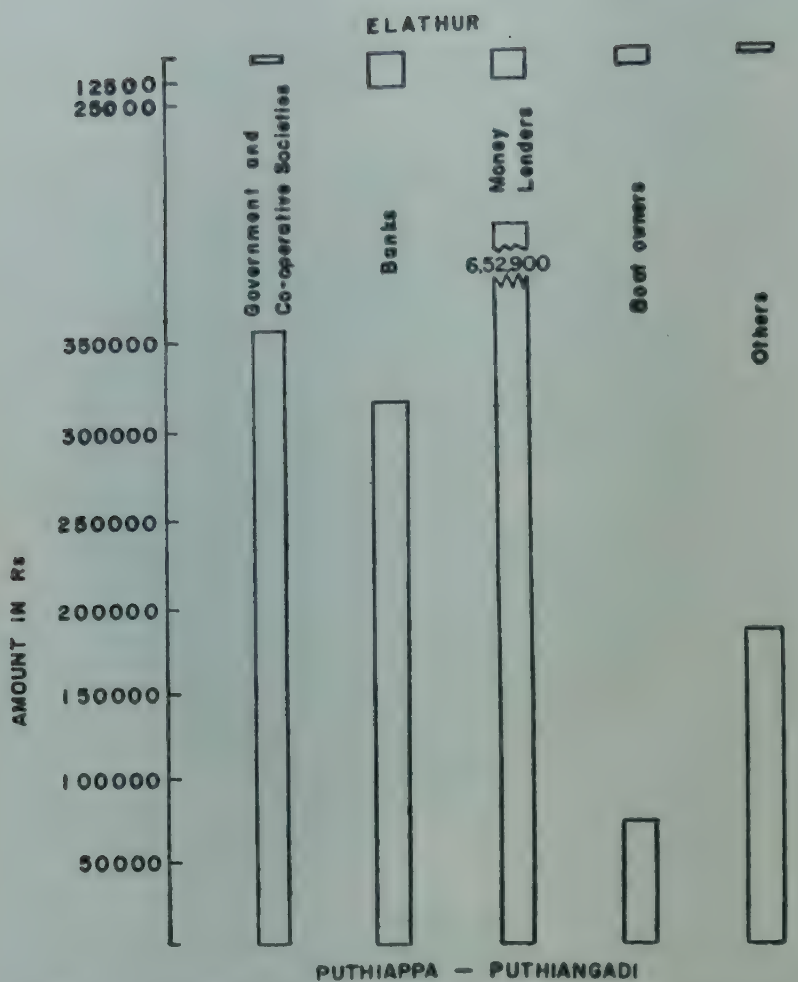

Fig. 5. Contribution of different credit agencies to the total loan amounts advanced to fishermen community.

and Rs. 38,59,762 respectively. Thus the money income created by this project has got direct impact on the economy of this area. The wages and commission (Rs. 58,65,024) received by fishermen, have increased the demand for goods and services in the village. An increase in income will increase consumption especially in a poor community whose propensity to consume is very high. More consumption means more demand which will ultimately stimulate the economic activities of the village. There will be a proliferation of allied activities such as fish trading, processing, ice factory, net repairing etc. which will create additional employment not only in the fisheries sector, but also to a certain extent in other sectors. In this way the additional income created by mechanisation in this area has obviously a positive impact on its economy.

Conclusion

The analysis of data relating to the socio economic background of the fishermen families in Puthiappa-Puthiangadi and Elathur clearly indicates the improvement of the economic condition of the fishermen families in the former region which received credit facilities from ARDC to acquire mechanised boats. Eventhough the beneficiaries of this scheme are 200 families constituting only one-fourth of the total fishermen families, the whole fishermen community in this area has received the spill over benefits of this scheme. Moreover, this project is characterised by the existence of certain externalities. The introduction of mechanisation by ARDC in this area in 1971–72 induced many other fishermen to shift from traditional to mechanised fishing which resulted in increased landings and created more employment opportunities in net making, ice plant and work shop operations, sorting, auctioning, transporting and fish trading. The absence of such economic activities in the neighbouring Elathur village is a pointer to the importance of availability of credit facilities to invest in improved fishing techniques.

Another important feature observed in Puthiappa-Puthiangadi area is the compatibility of mechanised and indigenous fishing sectors. This may be because during off-season, mechanised boats are used for towing 5 to 10 country crafts to operate at distant grounds. Moreover, most of the mechanised boats belong to local fishermen families.

ARDC advanced loan to fishermen through the co-operative society at Puthiappa-Puthiangadi. The repayment of loan is the responsibility of the society. The fishermen to whom the boats are allotted have to hand over to the society certain percentage of their daily catch and from that, the society will repay the loan. Because of this arrangement, delay in realising the loan is avoided. This can be taken as a guide line for advancing loans in other rural areas also.

Despite the higher level of average annual income per household and also higher tempo of economic activities in Puthiappa-Puthiangadi as compared to Elathur village the intensity of indebtedness is more in the former than in the latter village. This can be attributed to the absence of credit facilities in Elathur, especially the institutional credits and the reluctance of the money lenders there to advance credit to poor fishermen whose repaying capacity is very poor. Thus a lower degree of credit facilities in any fishing village may be an indicator of its lower level fishing activities.

MUSSEL CULTURE AT KARWAR, KARNATAKA STATE*

Lab-to-Land Programme

The green mussel, *Perna viridis* is an important item of food of the people of coastal Karnataka. The mussel popularly known as 'Neeli Kallu' in Kanarese and 'Kulate' in Konkani and Marathi occurs abundantly on rocks and other hard substrata in the inshore waters all along the coast. It supports a sustenance fishery of some consequence along the 144 km Uttar Kannada (North Kanara) coast from Majali in the north to Bhatkal in the south. The fishermen supplement their earnings by taking to mussel fishing not only during lean but also good seasons of mackerel, oil sardine, prawn and other fisheries. Mussel of marketable size harvested from natural beds fetch Rs. 10/- to Rs. 15/- per hundred in the locality and medium-sized ones Rs. 1/- to 3/- per hundred. But, the production from natural sources falls far short of the requirements of the people. In order to augment production of quality mussel through coastal aquaculture, the Lab-to-Land Programme for transfer of mussel culture technology to the fishermen of Binage, a fishing hamlet situated 7 km south of Karwar town, was initiated in November 1980.

The programme was channelled to ten fishermen, each representing one family of the low income group. These fishermen operate the traditional shore seines, 'Rampan' and 'Yendi' in the area. The rationale in selecting them for implementation of the programme is that once they feel that the rafts placed are their own and derive good returns from them, they would so reorient their traditional fishing activities as not to disturb the rafts in the sea which in turn ensures their total involvement in the programme and its success.

The Binage coastal village is part of the Karwar Development Block of Uttar Kannada (North Kanara District), Karnataka State. The village comprising 4 wards is densely populated. The fourth ward of the village is occupied exclusively by the fishing community comprising 134 families of 846 members.

As a first pre-requisite to the implementation of the programme, the Bench Mark Survey on the socio-economics of the fourth ward in general and the selected families in particular was taken on hand and completed on schedule. The selected ten families have 30 male and 18 female members, of whom 10 are children below the age of 14. Among the adults, 23 males are engaged in 'Yendi' operations; they also work as labourers in the 'Rampan' units. Of the 15 females, 7 eke out a living by selling fish in the local market and the rest attend to domestic chores. The ten families are categorised under the low income group.

Raft culture

The mussel culture programme could be implemented only after imparting training to the 10 involved fishermen and other members of the adopted families in all phases of culture. The fishermen were trained in the selection and preparation of material and fabrication of the rafts, floating and mooring the rafts at sea, location and collection of seed of the required size, cleaning the seed and seeding the ropes, suspending seeded ropes from the rafts and maintenance of the rafts at sea including periodical cleaning of the ropes to remove epifauna and fouling organisms. Training was imparted to the women and other members of the families in cleaning the seed and seeding the ropes.

The mussel culture rafts were located in two areas, viz., Binage Bay and Karwar Bay. Four rafts, two each at Binage and Karwar, fabricated out of casuarina and bamboo poles (tied together with coir and nylon ropes) and varying in size from 5 x 5 to 7 x 7 m were used for suspending the seeded ropes. Sealed empty oil barrels, each of 200 litres capacity, were used as floats for the rafts. Each raft was moored in the sea by means of two 100 kg iron anchors and 11 mm link diameter 20 m long iron chains at 6 to 7 m depth about 2 km from the shore. Initially, attempts were made to place the first raft near the Hulchi Rock off Binage as this area afforded protection to the raft from wave action and purse seiners. But, because of predation by fishes on transplanted mussel seed, the raft had to be moved and placed at a safer location between Hulchi Rock and Anjadiv Island. The second raft at Binage was moored near the first. These rafts of size 7 x 7 and 6 x 6 m floated on 16th December 1980 and 6th February 1981 had the full complement of 48 and 41 seeded ropes by 22nd January and 21st February respectively. In the Karwar Bay, the rafts of size 5 x 5 m floated on 23rd January and 24th February had the full complement of 33 and 32 seeded ropes by 6th February and 13th March 1981 respectively.

The seed for the programme emanated from the intertidal and submerged rocks situated in the vicinity

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* Prepared by M. Vasudev Pai and P. S. Kuriakose

Fig. 1. Rafts in position in the Binage Bay

Fig. 3. Ropes being examined for growth of mussel

Fig. 2. Maintenance of raft at sea

Fig. 4. Lab-to-Land Programme participants with the harvest

Fig. 5. Harvested mussel ropes.

of the Karwar Research Centre of CMFRI and also Chendia. Immediately after collection, the seed were cleaned thoroughly to remove adhering mud and epifauna. Four kg of cleaned seed of size 10 to 20 mm go into the seeding of 4 m length of coir ropes of 20 mm diameter. The seed mussel were secured around the rope by stitching knitted cotton cloth of 25 cm width. The ropes, each with 4 m seeded length, were suspended from the rafts with the lower free end about 2–3 m above the bottom of the sea. The seed mussel got attached to the ropes by means of freshly secreted byssus thread in a matter of days when the cloth cover disintegrated.

The growth particulars of cultured mussel are presented in Table 1. Seed mussel having an average length of 17.50 mm and weighing 0.51 g transplanted on 20th January grew to a size of 62.60 mm weighing 14.70 g within a period of 134 days registering an average monthly growth rate of 10.10 mm in length and 3.18 g in weight. The maximum meat yield was 38.10% of the total weight obtained at the time of harvest on 4th June 1981.

Though the cultured mussel had not grown to marketable size, it was decided to harvest the crop and retrieve the rafts from the sea for future use because of the turbulent sea conditions during the South West Monsoon. The mussel were harvested from 2nd through 12th June 1981. The details of production, etc., are given in Table 2. In all, 3,751 kg of mussel were harvested from 120 ropes (480 m seeded length) recovered from the four rafts. But for the 3 ropes lost at sea, the recovery of seeded ropes was near-total and 2,080 kg of mussel were harvested at Binage. The average production per metre length of rope was 7.815 kg of mussel showing 7.815 times increase in seed weight. At Karwar, 31 ropes with harvestable sized mussel were lost due to poaching and 1,671 kg of mussel were obtained from other ropes. A good part of the harvest was distributed free among the 10 Lab-to-Land participants as also local fishermen and the public of Karwar as part of the Institute's extension programme and the rest sold.

Fishermen and the public alike had visited the Karwar Research Centre to see the harvest for themselves, the first to be witnessed in the area. Kumari Sobha Nambisan, I.A.S., the then Project Director, District Rural Development Society (erstwhile SFDA), Karwar evinced keen interest in the programme. The programme has so impressed the fishermen of Karwar as to make them feel that mussel culture is a viable proposition and can be relied upon to augment their meagre income.

Table 1. *Growth of the cultured mussel, Perna viridis. (The figures of length and weight are averages of* 100 *specimens).*

Date of observation	Length (mm)	Total weight (g)	Shell weight (g)	Meat weight (g)	Mantle water weight (g)	Percentage of shell weight	Percentage of meat yield	Percentage of mantle water weight
20–1–1981 (seed)	17.50	0.51	0.11	0.12	0.28	21.57	54.90	23.53
23–2–1981	30.24	2.38	0.73	0.79	0.86	30.67	36.13	33.19
11–3–1981	35.88	3.46	1.10	0.93	1.43	31.79	41.33	26.88
1–4–1981	44.90	6.63	2 28	2.32	2.03	34.39	30.62	34.99
1–5–1981	50.00	8.20	3.06	2.98	2.16	37.32	26.34	36.34
26–5–1981	58.44	13.74	4.84	5.00	3.90	35.23	28.38	36.39
4–6–1981	62.60	14.70	5.00	5.60	4.10	34.01	27.89	38.10

Read the figures in the last

Table 2. *Details of rafts and production of mussel.*

Details of rafts	Binage Bay		Karwar Bay	
	Raft No. 1	Raft No. 2	Raft No. 1	Raft No. 2
1. Size of the raft (m)	7 x 7	6 x 6	5 x 5	5 x 5
2. No. of ropes suspended	48	41	33	32
3. Length of seeded rope (m)	4	4	4	4
4. Weight of seed used for seeding one metre length of rope (kg)	1	1	1	1
5. Date of seeding	18–1–81 to 22–1–81	6–2–81 to 21–2–81	23–1–81 to 6–2–81	24–2–81 to 13–3–81
6. Date of harvest	2–6–81	9–6–81	12–6–81	12–6–81
7. No. of ropes harvested	45	41	16	18
8. Total weight of the harvest (kg)	1275	805	786	885
9. Average yield per metre length of rope (kg)	7.1	4.9	12.3	12.2
10. No. of ropes lost due to poaching	—	—	17	14
11. No. of ropes lost in choppy seas	3	—	—	—
12. Weight of mussel distributed in the village (kg)	—	805	386	485
13. Weight of mussel sold (kg)	1275	—	400	400
14. Amount realised from the sale (Rs.)	700/-	—	144/-	85/-

Shri P. M. Tandel, Managing Director, M/s Binage Ice & Cold Storage (Private) Ltd., Binage, Karwar and Member, CMFRI Management Committee was of considerable help in motivating the fishermen to take to mussel culture under the Lab-to-Land Programme. The help rendered by the staff of the Karwar Research Centre of CMFRI at various stages of the implementation of the programme is gratefully acknowledged.

FISH TECHNOLOGY EXPERIMENT STATION
C.F.T.R.I.
MANGALORE.

ON THE RARE OCCURRENCE OF A GIANT SIZED HAWKSBILL TURTLE OFF ELEPHANTA CAVES (NEAR BOMBAY)*

A turtle weighing 80 kg was caught in a 18.3 m long and sturdy drift net (called *"Jali"* in Maharashtra) operated off Elephanta Caves, a rocky and sandy sea resort of historical and tourist interest about 18 km south of Bombay, on 2–9–1981.

This turtle (Fig. 1) was reported to have been caught, accidentally, by a fisherman Shri Vaman Kusha Koli of Trombay, coinciding with a festival day of Ganesh Chaturthi while he was hauling his drift nets. As the turtle was struggling for its escape

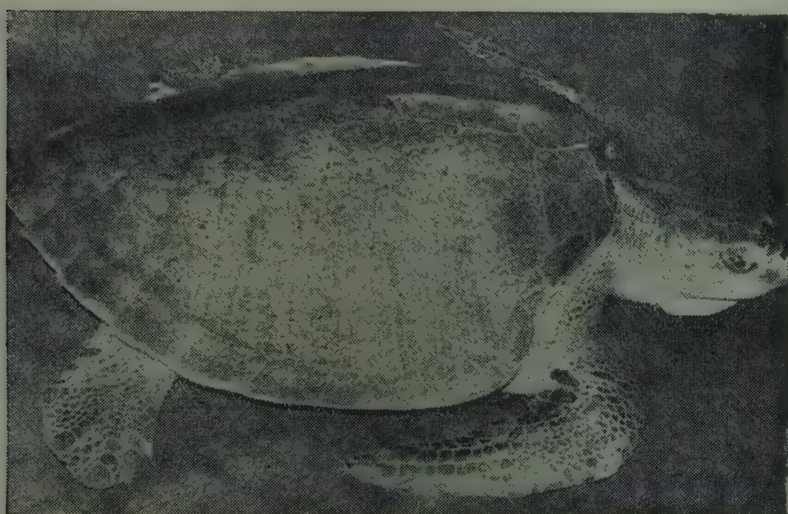

Fig. 1. The hawksbill turtle, Eretmochelys imbricata (Linnaeus) caught off Elephanta Caves (near Bombay)

from the net, the fisherman had to cast another net to control the wildly struggling creature for its inescapable watery journey from Elephanta Caves to a fishing village near Trombay where it was kept alive in captivity.

The following observations were made on the morphometry of the turtle as well as other interesting characteristics of the animal, which was identified as *Eretmochelys imbricata* (Linnaeus):

1. Total length of the turtle from snout to the tail ... 1213 mm
2. The length of carapace ... 783 mm
3. Width of the carapace along the curveture ... 613 mm
4. Width of the carapace in a straight line ... 448 mm
5. The length of plastron ... 438 mm
6. Number of barnacles and other epizootic organisms on the carapace and head ... 8 nos.
7. Number of costal scutes ... 4 pairs
8. Number of inframarginal scutes ... 4 pairs
9. Length of ear-like foreflipper ... 348 mm
10. Number of pre-frontal scales ... 2 pairs
11. Total weight of the turtle ... 80 kg
12. The scutes were very thick, measuring about 5 mm thickness.
13. Head was narrow, parallel-sided and with the jaws meeting at a highly acute angle, which facilitates extraction of food organisms from crevices in coral reefs.
14. Nuchal scute was separated from the first costal scute.
15. The colouration of the dorsal scutes was attractive with radiating streaks of brown and black in an amber substrate.
16. The plastral scutes were orange-yellow in colour.
17. Jaw surfaces were not serrated and the bill was bird-like.
18. The scales of head and forelimbs were very distinct, each being dark-brown with a light border.

It was a female specimen and she got entangled in the drift net, presumably, during her nocturnal egg-laying journey towards the rocky and sandy shore of Elephanta Caves-which serves as an ideal nesting place for hawksbill turtle.

The turtle was kept alive under captivity, for six days in the ante-room of a fairly large house of the captor of the turtle, who regarded the capture of turtle as auspicious and labelled it as "Sea God", duly worshipped by the offering of rice and vermilion.

Since the animal was registering its protest of the captivity by starvation and there was no possibility of keeping it in the local zoo because of the restrictions under the Wild Life (Protection) Act, 1972, it was released back into the sea on September 7, after six days of its capture.

Earlier records of hawksbill turtle reveal that it grows upto 724 mm in carapace length and weighing 50 kg as reported off Jabal Azig Island, in the Gulf of Aden. The present record of the hawksbill from the Arabian Sea off Bombay appears to be the highest both in carapace length and weight.

Grateful thanks are expressed to Dr. E. G. Silas and Dr. S. Ramamurthy for kindly going through the manuscript critically.

*Prepared by J. P. Karbari, Bombay Research Centre of CMFRI

OCCURRENCE OF SMALL SIZED SEER FISHES *S. GUTTATUS* AND *S. COMMERSON* AT KARWAR (KARNATAKA)*

While examining a rampan catch on 3rd December 1981, small sized *Scomberomorus guttatus* (Fig. 1) were observed along with mackerel. The sizes ranged from 52 mm to 96 mm with modal length at 72 mm. Again a few of these were observed in the same gear on 8th and 9th instants, the sizes ranging from 76 mm to 116 mm and modes at 97 mm.

Fig. 1 *S. guttatus*

On 8th, 9th and 17th instants, a few numbers of *S. commerson* (Fig. 2) were also picked up. The minimum and maximum size recorded for this species was 83 and 139 mm respectively.

Small sized *S. guttatus* and *S. commerson* could be identified based on some external features. The height of body in the latter species is more than in the former. The second dorsal fin in *S. commerson* is tinged as brightly yellow as its caudal fin, whereas in the other species it is lacking. The characteristic steep slope of lateral line below second dorsal fin which distinguishes the adults of the two species is also clearly discernible. Another added feature to identify these two species is based on dentition. In *S. guttatus* the teeth on the lower half of the jaw are of villiform type and are more in numbers whereas in the other there are 6–7 prominent teeth pointing backwards with fairly

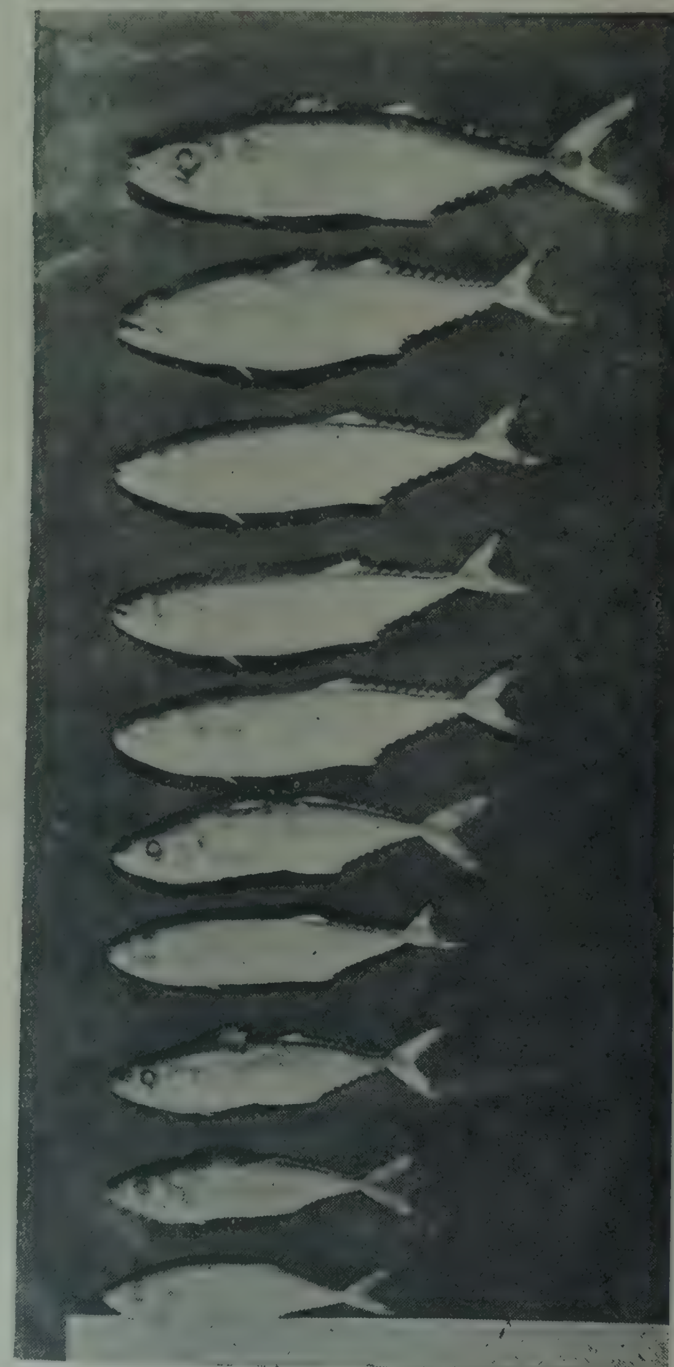

Fig. 2. *S. commerson*

*Prepared by M. H. Dhulkhe

equal gap between two teeth, by and large the alternate tooth being bigger.

Small sized *S. guttatus* have been recorded from Waltair and Tuticorin on the east coast and from Veraval, Ratnagiri and Vizhinjam on the west coast. At the last centre these were reported to have been observed during February, March and May in the shore seine catch along with *S. commerson*. Nevertheless, the occurrence of these two species in the Karwar waters during December indicates the protracted nature of spawning in these species and the probable region.

NEWS—INDIA AND OVERSEAS

Mechanised fishing vessel disasters along Karnataka coast

Eight mechanised boats were involved in accidents in the sea between Mangalore and Honavar along Karnataka coast on 8th–9th September, 1981. A purse-seiner, a carrier boat and a trawler capsized at the mouth of Nethravathi estuary at Mangalore on 8th September. A trawler at Coondapur and a purse-seiner at Honavar met similar fate on the same day while three mechanised boats anchored at Pollippu were heavily damaged in the early hours of 9th September, 1981 lashed by waves and wind.

The three fishing boats capsized outside Nethravathi estuary due to water currents and wind at the mouth of the estuary. The purse seiner *Pancha Durgi* a 46′ vessel with 100 H.P. Leyland engine was owned by ex-rampan net owners. The boat fell to a side and the crew swam to safety. Two of them were injured and were treated in hospital. The hull and engine were very much damaged. The boat was salvaged and pulled to the sea coast at Bengre by a large number of fishermen of the area on the next day. *Noor Madani* a 32′ trawler, equipped with a 40.7 H.P. Ruston engine, while trying to enter the estuary turned turtle due to water currents and waves. One of the six crew was drowned. The carrier boat *Jaya Ganga,* a 32′ vessel fitted with 49 H.P. Ruston engine also sank at the mouth of the estuary All the four crew were rescued by other boats in the area

On the same day a 32′ trawler with H.P. Ruston engine *Syed Madani* sank opposite Coondapur estuary at 1 p.m. as it was attempting to enter the estuary. The six crew swam ashore but four trawl nets abroad the boat were lost. The trawler was salvaged and pulled ashore on the next day.

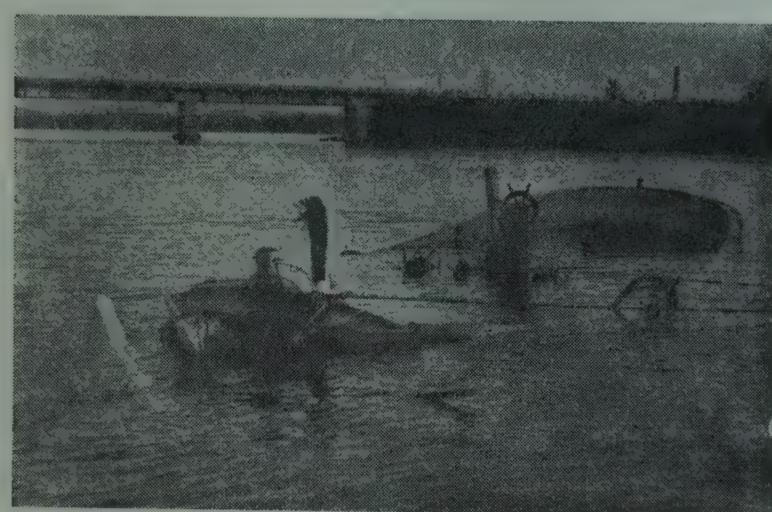

Fig. 1. *"Durga Parameshwari"* capsized on 8th Sept. 81 while negotiating the river bar at Honavar.

The purse seiner *Durga Parameswari* belonging to ex-rampan fishermen of Karwar sank on 8th September 1981 afternoon as it was trying to enter Sharavathi estuary at Honavar after fishing (Fig. 1). This vessel was launched only a week earlier on 2nd September,

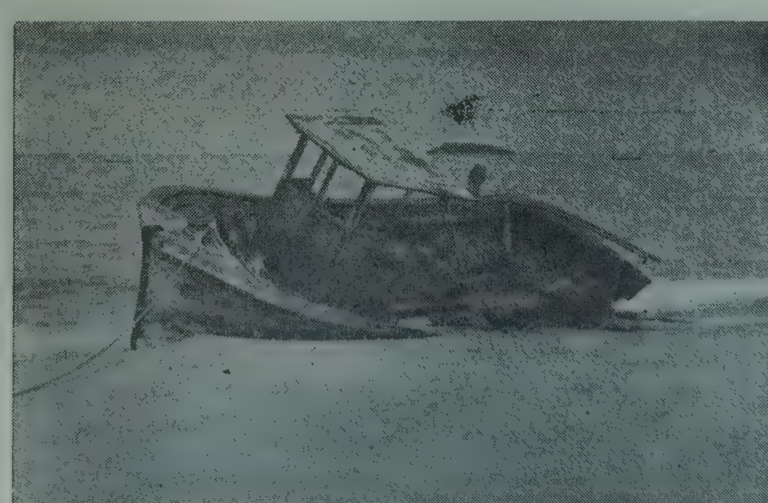

Fig. 2. A view of the 32′ trawler *Maheswar Prasad* which ran aground at Polippu with the badly damaged wheel-house and hull.

1981. The boat was completely damaged and the net lost. Out of 27 crew, eighteen swam to safety and nine lost their lives.

Besides the above five boats, a 36′ purse seiner *Sagar Ratna*, a 30′ carrier boat *Jeevan Ratna* and a 32′ trawler *Maheswar Prasad* anchored off at Polippu, 48 km north of Mangalore ran aground in the early hours of 9th September under the impact of waves and wind and were damaged considerably. There were heavy damages to the hulls, engines and nets (Fig. 2).

All the boats except the carrier boat *Jeevan Ratna* were insured and the owners of the boats have submitted claims to the Insurance Companies. The tragic mishaps to these fishing boats at Mangalore, Coondapur and Honavar indicate the urgency for construction of breakwaters at the mouths of the estuaries and deepening of channels by dredging regularly. Dredging operations at the entrance of the estuaries is quite essential as a large number of mechanised fishing boats regularly use the passages to go for fishing and the safety of fishermen has to be assured. The accidents at Polippu have brought to focus the risks involved in anchoring mechanised vessels in coastal waters, however protected they may appear to be. It is quite necessary that mechanised fishing boats, which are extremely costly are berthed in fishing harbours or sheltered areas.

Reports from Mangalore and Karwar Research Centres of CMFRI.

Octopus demand in Japan

Nearly seventy per cent of the total world production of Octopus is consumed in Japan. *Octopus dofleini*, the Pacific Octopus contributes to the major part of this production The catch of Octopus in Japan totalled about 63,000 tonnes in 1978 and with 74,000 tonnes imported from outside, the total quantity amounted to 137,000 tonnes There are widely different fishing methods for octopus in use in Japan, longline fishing using baits, trap method utilising the instinctive nature of the animal and small trawl net fishing.

The Japanese use octopus for food in many different ways. It is never eaten raw, but boiled first and then processed into various products like boiled octopus, vinegered octopus, flavoured items and smoked items. Octopus is an even more favourite food than other fish in Japan, with extremely stable demand and consumption.

World Fishing 29 (11): November 1980

Typhoons improve the fishery

In the Philippines a recent study as part of a three year research programme called "Pollution, Resources, Environment and the Philippines Future" (PREPF) has shown that typhoons could help fishery industry.

According to the study, the fishery resources of the Philippines are not as rich as those in temperate areas because there is less frequent turbulance in its waters except during the southwest monsoon when typhoons occur. The violent agitation of the waters during a typhoon enables nutrients to circulate from the bottom of the sea to the near surface of the waters, thereby enriching these areas. Major part of the fish caught by Fillipino fishermen comes from the surface waters, the pelagic fishery of the Phillippines contributing to nearly 64 per cent of the total fish production.

World Fishing 30 (6): June 1981

Workshop on shrimp fishery management

A workshop on the scientific basis for the management of penaeid shrimp, jointly sponsored by the Fishery Resources and Environment Division of the Food and Agriculture Organisation (FAO) of the United Nations, Rome, U.S. National Marine Fisheries Service (NMFS), Southeast Fisheries Center, Florida and Gulf States Marine Fisheries Commission, Mississippi was conducted at Key West, Florida from November 18 to 24, 1981. Representing different countries and organisations 44 delegates participated in the workshop.

Based on country review papers presented, detailed discussions were held on topics of interest in the penaeid shrimp fisheries of the world. In addition to delineating the problems of research, discussions centred around biological aspects of importance in shrimp fisheries, multiple species problems, environmental aspects, management and future course of work. On the basis of the discussions and comments, recommendations for further follow up action concerning the main items of consideration were given. The proceedings of the workshop will be published shortly.

Legal control of Marine Pollution: By C. K. Chaturvedi, Deep & Deep Publication, New Delhi, pp. 240, 1981.

Half the biological productivity of the world's oceans occurs in the coastal regions of the sea. Commercial fishing in coastal waters is an important industry. It is a tourist region with significant tourist business. It has been recognised that marine environment and all the living organisms which it supports are of vital importance to humanity, and all people particularly of the coastal states have an understandable interest in assuring that this environment is so managed that its quality and resources are not impaired.

This book is primarily devoted to a critical analysis of the issue concerning legal control of marine based pollution. The appendix to the book reproduces in full four Geneva Conventions on the Law of the Sea; the Indian Territorial waters, continental shelf, EEZ and other Maritime Zones Act of 1976, the recent draft convention of the Law of the Sea (extracts) and some other conventions relevant to pollution control. This book will be useful to those engaged in shipping industry, governments and citizens of coastal states, students of law offering law of the sea at higher studies and those connected with sea industries or interested in healthy and unpolluted environment.

Chemoreception in Fishes: Edited by Tashiaki J. Hara, Elsevier Scientific Publishing Company, Amsterdam, pp 433, 1981.

This is the eighth volume in the series, Developments in Aquaculture and Fisheries Science. It is a review of chemoreception in fishes with particular emphasis on its significance in behaviour and its environmental interactions. Four aspects are discussed in the light of recent developments in electron microscopical, electrophysiological and biochemical studies while searching for the general, fundamental mechanisms of chemoreceptive transduction: (a) the morphology, development and differentiation of the peripheral chemoreceptor organs, with some discussion of the central neuronal organisation in the olfactory organ, (b) the primary sensory process in the olfactory and taste as well as lateral-line organs with special emphasis on electrophysiological and biochemical aspects of amino acid receptors; neuronal correlates of olfactory behaviour and its role in orientation, (c) the role of chemoreception in behaviour with particular reference in identification of feeding stimulants and its application to artificial baits, alarm substance fright reaction system and its adaptive significance, and olfactory imprinting to an artificial chemical in homing salmonids, and (d) interactions between aquatic pollutants chemoreceptors and resulting behaviour.

Compiled and prepared by M. J. George & G. Subbaraju.
Published by Dr. M. J. George, Senior Scientist on behalf of the Director, Central Marine Fisheries Research Institute, Cochin-682 018 and printed at PAICO, Cochin-31

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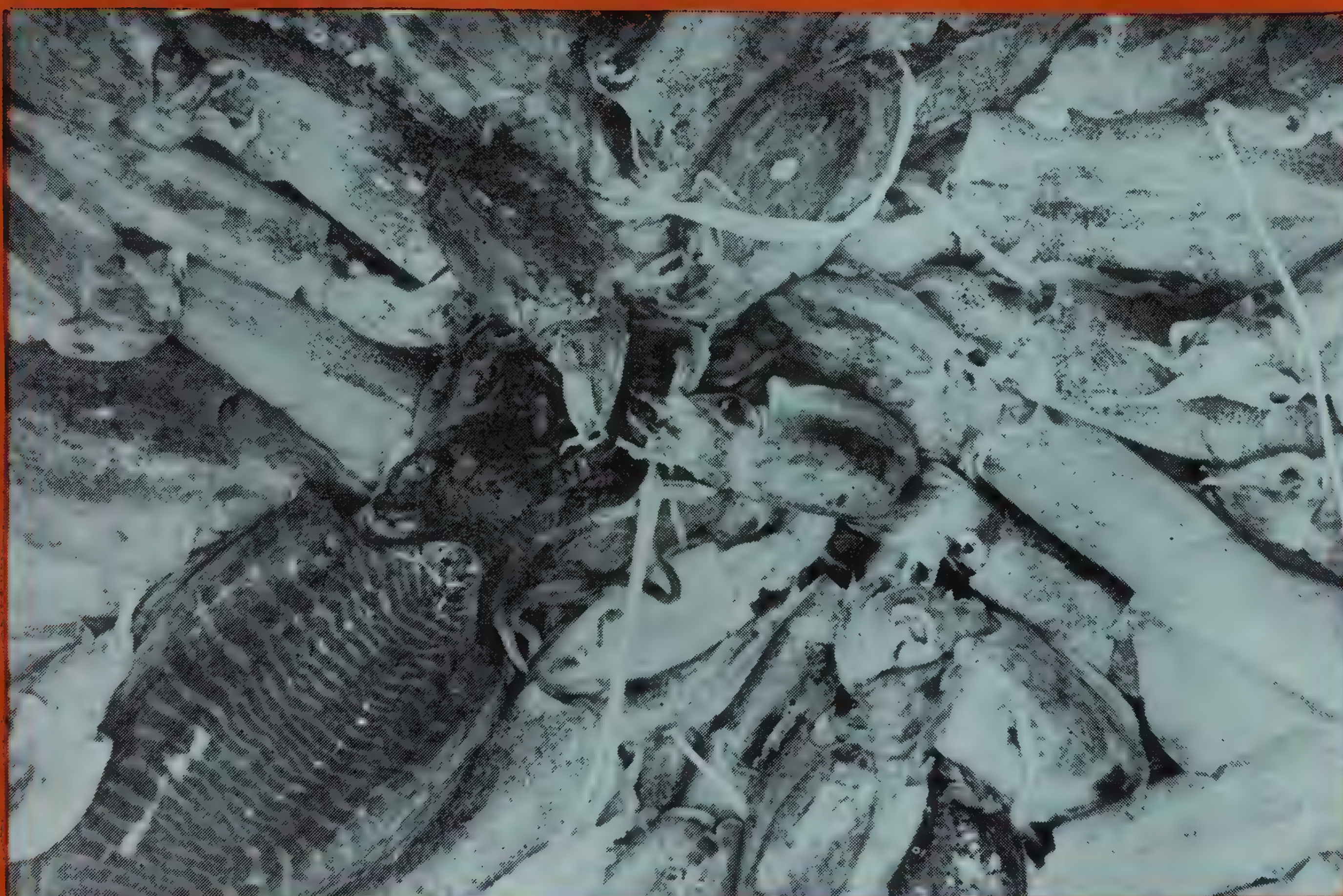

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Abbreviation - *Mar. Fish. Infor. Serv. T & E Ser., No.* 34: 1982.

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1. The exploited squid and cuttlefish resources of India: A review
2. Books

Cover photo: A collection of squids and cuttlefishes

THE EXPLOITED SQUID AND CUTTLEFISH RESOURCES OF INDIA : A REVIEW*

E. G. SILAS, K. SATYANARAYANA RAO, R. SARVESAN,
K. PRABHAKARAN NAIR AND M. M. MEIYAPPAN

Central Marine Fisheries Research Institute, Cochin

1. THE PROBLEM

Squids and cuttlefishes are one of the important marine fishery resources of India, ranking next only to finfishes and crustaceans (shrimps and lobsters). At present they are landed mostly as incidental catches in the traditional fisheries in gears such as shore-seines, boat seines, stake nets and hooks and line and in the mechanised boats operating trawl nets. Their exploitation is confined to the coastal waters extending to about 45 m depth on the east and west coasts. Till recently the squids and cuttlefishes have met the limited demand in coastal areas as food and as bait in the hooks and line fishery. In 1973 the export of squids and cuttlefishes commenced, and their growing demand in foreign trade as a valuable seafood served as an impetus for increased landings in the country. However, this rise in production is not substantial, as efforts have not been made to adopt specialised gear suitable for the capture of squids and cuttlefishes. Although the cephalopod fishery has shown an upward trend, there is vast scope for stepping up production by employing modern fishing methods.

Exploratory fishing conducted recently (Silas 1968, 1969; Filippova 1968; Anon. 1979) have revealed the existence of squid and cuttlefish resources in the continental shelf and oceanic areas. With the declaration of the Exclusive Economic Zone there are vast stretches of fishing areas where fishing for squids and cuttlefishes could be carried out profitably. Recognizing the importance of these resources, the Central Marine Fisheries Research Institute initiated investigations on the fisheries, resources characteristics and biological aspects of cephalopods at important fishing centres along the east and west coasts for a better management of the resources. The synoptic information presented in this paper is mainly based on the results obtained on the fishery and biological investigations conducted during 1976 to 1980 which are reported in detail in a separate publication of the Institute (Silas *et al.*, MS).

2. EARLIER WORKS ON CEPHALOPODS IN INDIA

The identity and systematics of cephalopods of the seas around India have been studied by Hoyle (1885), Goodrich (1896), Massy (1916), Robson (1921), Adam (1939 a, b) and Adam and Rees (1966). Silas (1968) has given a catalogue of the known species from the Indian Ocean together with an account of the distribution and abundance of larvae and juveniles of cephalopods collected from the continental shelf and continental slope off the west coast of India. The common species of squids and cuttlefishes and their fisheries have been briefly dealt with by Hornell (1917), Rao (1954, 1958, 1969, 1973), Jones (1969), Sarvesan (1974) and Silas *et al.* (1976). Rao (1954) has given an account of the biology and fishery of one of the economically important species of squid *Sepioteuthis arctipinnis* (= *lessoniona*) which forms a fishery in Palk Bay and Gulf of Mannar along the southeast coast of India. Silas (1969) has recorded schools of *Symplectoteuthis oualaniensis*, an important oceanic squid, from the continental shelf and beyond in drift net catches off Kerala and Karnataka and Lakshadweep Sea. He also reportd on the catch rates of cuttlefishes from the continental shelf along the southwest coast of India based on exploratory trawl surveys. Filippova (1968) has reported on the distribution and latitudinal zonality of oceanic squids in the Indian Ocean. Oommen (1977) has studied the food and feeding and fishery of some cephalopods of the west coast of India.

3. BIOLOGY

The biology of the commercially important squids and cuttlefishes of India are dealt with below.

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*For the Project Programme, field collections have been carried out at different centres along the coast. S/Shri Kuber Vidyasagar, P. V. Sreenivasan, Y. Appanna Sastry and B. Narayana Rao have helped in collecting from Bombay, Portonovo, Kakinada and Waltair respectively.

3.1. **Loligo duvaucelii** d'Orbigny (Plate II)

3.1.1. Distribution

This is a neritic species of squid, widely distributed in the Indo-Pacific region along the coasts of India, Andaman Islands, Sri Lanka, Burma, South Africa, Red Sea, Malaysia, Hongkong, Indonesia, Philippines and Taiwan.

Distribution of juveniles

Juveniles measuring 20-40 mm have been collected off Sriharikota, Pulicat and Waltair on the east coast and Bombay on the west coast from the trawl net catches, and from shore seine and boat seine catches off Vizhinjam on the west coast.

Distribution of adults

Being a neritic species, the adults occur in shallow waters upto depths of 80 m on the continental shelf of the east and west coasts of India.

3.1.2. Bionomics and life-history

3.1.2.1. Reproduction

Sexuality

This squid is heterosexual as all other cephalopods. Males are distinguishable from the hectocotylization of the left ventral arm. The males grow to a larger size than females.

Sex ratio

The sex ratio was almost equal in squids of Waltair and Madras Coasts during 1976-80. At Cochin males were dominant in 1978 and 1980 (M 60 : F 40), while both the sexes were in almost equal proportion in 1976, 1977 and 1979. At Vizhinjam the two sexes were in about equal ratio in 1976, while in 1977-80 females outnumbered males (F 60 : M 40).

Maturity

On the east coast, the males attain maturity in the size range of 50-119 mm with 50% reaching maturity at a size of 76 mm. Females mature in the size range 70-139 mm with 50% being mature at 86 mm. On the west coast, males have been observed to be mature in the size range 90-169 mm with 50% maturing at 113 mm, while females mature when they are in the size range of 90-169 mm with 50% becoming mature at 118 mm (Fig. 1 A-G gives biological data and catch trends of this species at Cochin, one of the ten selected centres for detailed biological studies on squids and cuttlefishes).

Spawning

Mature and partly spawned individuals are found all round the year on both coasts and spawning is intensive in February and June-September at Madras, January, July and September at Waltair and February-March, May-July and September-October at Cochin.

3.1.2.2. Adult history

Size

The commercial catches consist of squids 60-289 mm in size. The species grows to a larger size on the west coast; the maximum size recorded on the east coast is only 179 mm.

Food

This species feeds on prawns, other crustaceans and fish. Among prawns, *Acetes* was the dominant food item along Waltair Coast. Cannibalism was also noticed.

Growth

It grows to a size of 64-83 mm at the end of six months and 113-125 mm at the end of one year on both the coasts. But as it grows to a larger size on the west coast, a size of 208-220 mm is attained by the end of two years and 263 mm by the end of three years.

Length-weight relationship

The length-weight relationship of this species on Cochin Coast has been studied. The rate of increase in weight in relation to length has been found to differ significantly in males and females. The allometric growth formula has been observed to be as follows:

In males, $W = 0.00103\ L^{2.2408}$
In females, $W = 0.0005655\ L^{2.3985}$

3.2. **Sepioteuthis lessoniana** Lesson (Plate I)

3.2.1. Distribution

This is a neritic squid which is very widely distributed in the Indo-Pacific, Red Sea, Arabian Sea, Bay of Bengal, Sri Lanka upto Japan.

Distribution of juveniles

Young ones 20-60 mm in size are common in the shallow littoral waters in Palk Bay near Mandapam and Rameswaram. Occasionally they are met with in Vizhinjam area also in very small numbers.

Distribution of adults

Adults of 60-335 mm are caught in coastal waters of Palk Bay and Gulf of Mannar in Mandapam area in shore seines and hand jigs. Moderate sized ones 120-180 mm are caught in trawling grounds around Mandapam. At Vizhinjam Bay they occur in very few numbers in shore seine and boat seine catches.

3.2.2. Bionomics and life-history

3.2.2.1. Reproduction

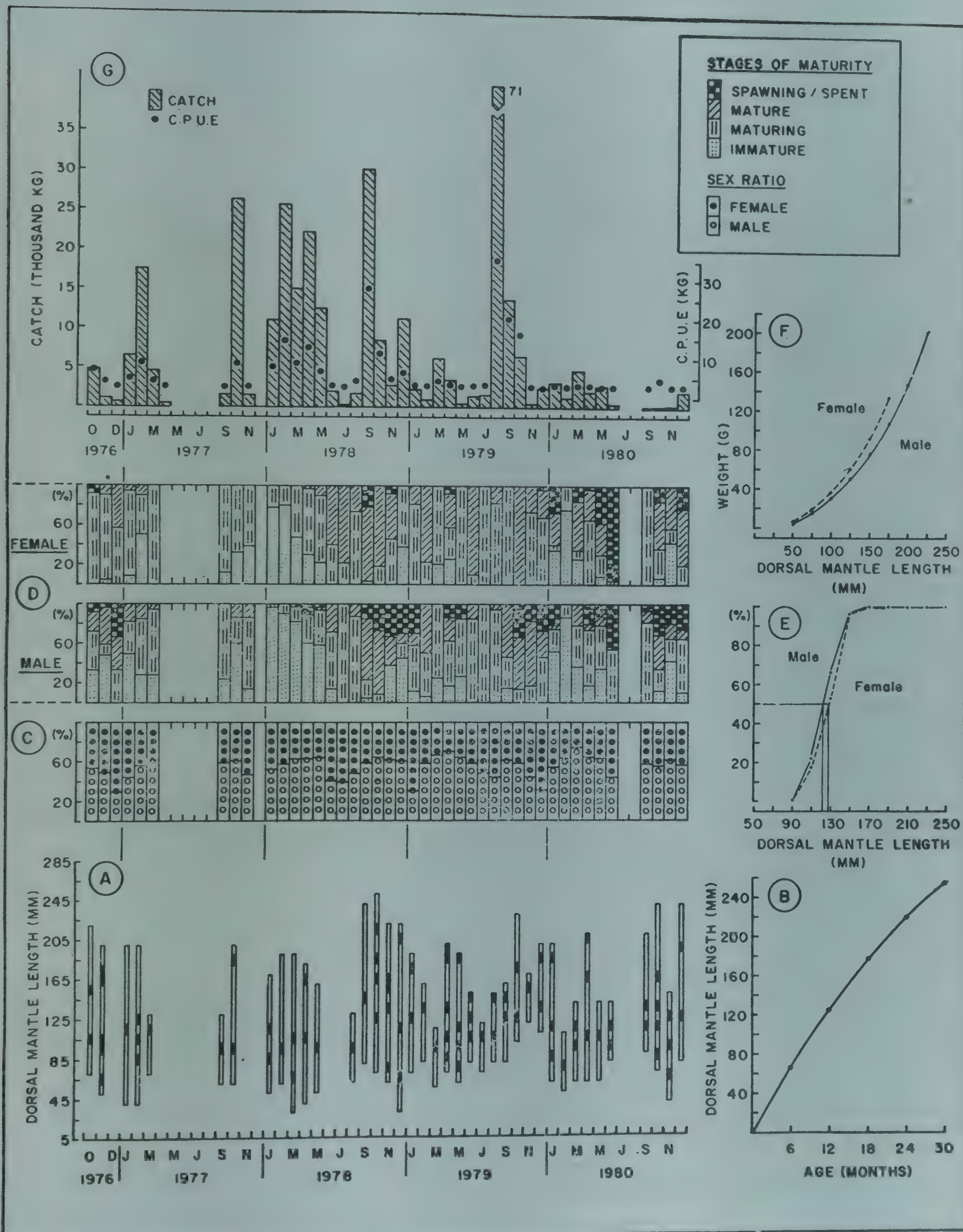

Fig. 1. Biological data and catch trends of *Loligo duvaucelii* off Cochin coast. A. Size range and modes. B. Growth curve. C. Sex ratio. D. Stages of maturity. E. Size at first maturity. F. Length-weight relationship. G. Trawl net landings.

Sexuality

Males can be recognised by the hectocotylisation of left ventral arm; transverse stripes on the dorsal side of mantle are more conspicuous than in females.

Sex ratio

In 1973 and 1974 the males were the dominant sex (M 61 : F 39 and M 58 : F 42 respectively).

Maturity

Males mature within a size range of 60-199 mm with 50% of the squids maturing at a size of 102 mm. Females reach mature stage in the size range 80-199 mm.

Spawning

Mature and spawning squids were found in the periods January-March and August-October. In some years mature ones were seen in October and December also. During spawning period which extends from January to June in Palk Bay and Gulf of Mannar the squids migrate to shallow waters to deposit their egg capsules (Rao 1954).

The egg capsules are finger-shaped and are attached as clusters to substrata such as algae, twigs, stones and corals. Each egg capsule measuring 62-68 mm in length 10-11 mm in breadth, contains 6 to 7 eggs 6 mm long and 4.6 mm in breadth arranged in a well spaced single row (Nagarswami 1966).

The newly hatched young ones resemble the adult and measure 7.5 mm in length and 5.0 mm in width. They are transparent and have chromatophores on the mantle, head, arms and dorsal surface of fins.

3.2.2.2. Adult history

Maximum size

The largest size observed in Mandapam area is 335 mm.

Food

Prawns and fish are the main food items. Stomatopods and crabs also form food in small percentage. A few instances of cannibalism were noticed.

Growth

This species grows to a size of 129 mm at the end of first year, 217 mm at the end of second year and 265 mm at the end of 2½ years.

3.3. **Doryteuthis** sp. (Plate II)

3.3.1. Distribution

Distribution of juveniles

Juveniles of 20 mm size and above occur in coastal waters at Vizhinjam in January-February and sometimes up to June.

Distribution of adults

Adults measuring 80-205 mm are found in coastal waters at Vizhinjam and are caught in sore seines, boat seines and the larger individuals in hooks and lines.

3.3.2. Bionomics and life-history

3.3.2.1. Reproduction

Sexuality

In addition to hectocotylization of left ventral arm, the males are larger than females, have generally slender body with ventro-medial concentration of chromatophores on the mantle.

Sex ratio

During 1976, 1978 and 1980 the females were in more numbers in the F : M ratio 60 : 40, 55 : 45 and 57 : 43 respectively but in 1979 males were dominant (M 59 : F 41), while 1977 both the sexes were in equal ratio.

Maturity

Males mature in the size range 85-189 mm with 50% of them attaining maturity at 126 mm. Females reach mature stage in the size 85-175 mm with 50% attaining the stage at 135 mm.

Spawning

Mature females occur in January-March, October and December. Mature males are found from January to April and October to December.

3.3.2.2. Adult history

Maximum size

The maximum sizes of males and females recorded were 205 mm and 165 mm respectively.

Food

The food of this species consists of fish, cephalopods and crustaceans.

Growth

This species attains a size of 113 mm at the end of the first year and 182 mm at the end of the second year at Vizhinjam. The longevity appears to be over two years.

3.4. **Sepia aculeata** Ferussac and d'Orbigny (Plate I)

3.4.1. Distribution

This is an Indo-Pacific species occurring in India, Sri Lanka, Singapore, Malaysia, Hongkong, Philippines and Taiwan to Japan. It is quite common along the east and west coast of India.

Distribution of juveniles

Juveniles measuring 20-50 mm in size occur in the

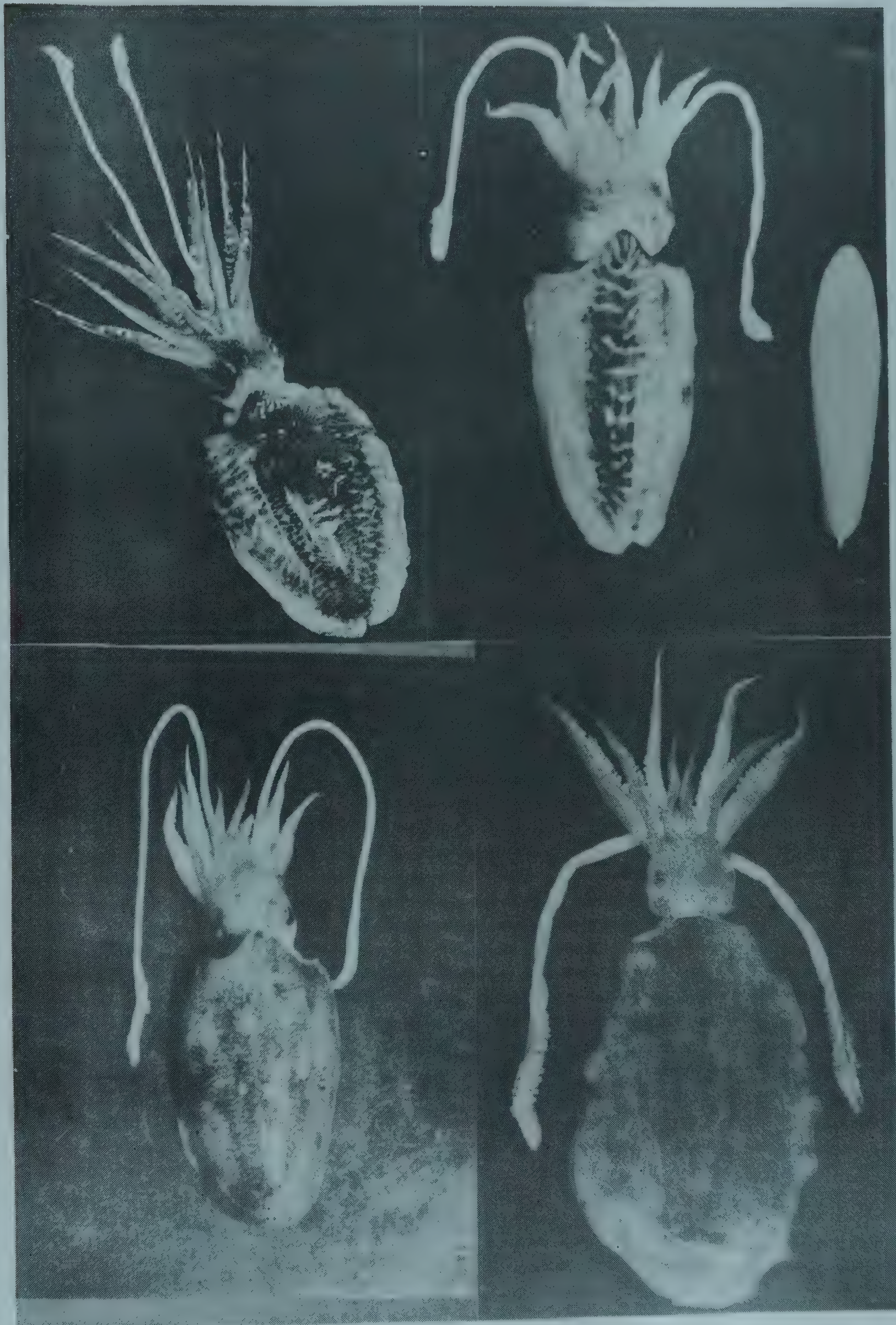

Plate I. Top left : *Sepia pharaonis*, top right : *S. prashadi*, bottom left : *S. aculeata* and bottom right : *Sepeioteuthis lessoniana.*

Plate II. Left : *Loligo duvaucelii* and right : *Doryteuthis* sp.

trawling grounds upto a depth of 40 m on the east and west coasts of India.

Distribution of adults

Adults in the size range of 60–190 mm support the fishery at Waltair, Kakinada, Madras, Mandapam and Cochin. Larger individuals measuring upto 245 mm have been recorded in the trawl landings at Bombay.

3.4.2. Bionomics and life-history

3.4.2.1. Reproduction

Sexuality

The male and female look more or less similar in external appearance except that in males the left ventral arm is hectocotylised.

Sex ratio

The sex ratio of males and females was almost equal at Mandapam and Waltair. The trend was similar at Madras except in 1976 (F 59 : M 41), 1978 (F 57 : M 43) and 1980 (F 58 : M 42) when the females were dominant. In Cochin during 1978, for which data were available, the male : female ratio was 67 : 33. In Bombay area also male dominance was observed in two years (1978–M 72 : F 28, 1979–F 52 : M 48 and 1980–M 58 : F 42).

Maturity

Individuals with gonads in maturing and mature stages are met with in all seasons of the year. Males mature at lengths of 70 mm onwards and the sizes at which 50% of them mature are 77 mm at Waltair, 100 mm at Madras and 83 mm at Mandapam along the east coast, and 124 mm at Cochin on the west coast. Females also mature 70 mm upwards. The size of 50% maturity of females has been estimated to be 102 mm at Waltair, 118 mm at Madras, 110 mm at Mandapam, 130 mm at Cochin and 132 mm at Bombay. Males attain maturity at the age of 7–9 months and females at 10–12 months along the east coast. In Bombay the females attain maturity at the end of one year.

Spawning

Spawning takes place in females throughout the year at Mandapam with peak activity from August to March. At Portonovo, spawning takes place in March, April, June and November. At Madras the spawning period extends from February to December with peak activity in February, June–August and October–December. At Waltair the season is from November to July with peaks during April, July, November and December. On the west coast spawning takes place in November–December at Cochin and in May, August, September and December at Bombay.

Eggs

During the spawning season egg clusters are commonly obtained in trawl nets on the east coast. Clusters of egg capsules attached to gorgonids have been collected from trawl catches off Ennore in fishing area 13–80/1C, at a depth of 25–40 m where the bottom has shells and gorgonids. They are also common in shallow coastal waters of Mandapam area, and are often obtained in shore seines and trawl nets from both Palk Bay and Gulf of Mannar.

3.4.2.2. Adult history

Maximum size

As mentioned earlier, cuttlefish upto a size of 245 mm were obtained in the trawl landings at Bombay, whereas in the catches at other centres the maximum size recorded was less, being 190 mm at Cochin, 199 mm at Mandapam, 155 mm at Portonovo, 180 mm at Madras and 185 mm at Kakinada and Waltair.

Food

Prawns and other crustaceans such as crabs and *Squilla* are the dominant food of *Sepia aculeata*. They also feed on fishes, polychaetes and other cephalopods.

Growth

This species grows to a size of 50–74 mm at the end of 6 months, 96–123 mm at the end of one year and 158–202 mm at the end of the second year. On Bombay Coast it grows upto three years, at the end of which a size of 236 mm is attained.

3.5. **Sepia pharaonis** Ehrenberg (Plate I)

3.5.1. Distribution

This is the largest among cuttlefishes and is widely distributed in the Indo-Pacific from Red Sea to Japan and Australia. In Indian waters it is abundant on both the coasts and supports commercial fisheries at many centres.

Distribution of juveniles

Juveniles are generally found in inshore waters and are caught in small numbers in shore seines, boat seines and among the miscellaneous catch in trawl nets from depth upto to 40 m, especially on the east coast. They are easily distinguishable from the juveniles of other cuttlefishes especially by the cuttlebone in which all the characteristic features of the species are apparent.

Distribution of adults

The adult individuals occurring along the west coast are larger in size as compared to those of the east coast. In general, the cuttlefish supporting the fishery on the east coast range between 110 and 189 mm as against those in the west coast where the range is 145–215 mm.

3.5.2. Bionomics and life-history

3.5.2.1. Reproduction

Sexuality

In the male, the ventral arm of the left side is hectocotylised. Besides this, sexual dimorphism exists in the colouration of the body in that the male has conspicuous brown stripes across the mantle, fins, head and arms. Males are relatively narrower than females, which are more muscular and robust.

Sex ratio

Females are dominant in catches obtained in hooks and line fishery at Vizhinjam in all the years, the maximum difference in the ratio being in 1976 (F 71 : M 29). The distribution of sexes in the commercial trawl landings at Madras also shows a preponderance of females. The F : M ratios for 1976-80 were 53 : 47, 62 : 38, 58 : 42, 60 : 40 and 53 : 47 respectively.

Maturity

There is variation in the sizes at which the males and females attain sexual maturity at different centres. The males become mature at a length range of 90-110 mm on the east coast and at 130 mm on the west coast. The size at which 50% of the males become mature is about 120 mm at Waltair and Madras when they are 8 months old. At Vizhinjam the corresponding size for males is about 145 mm when they are 6 months old and at Cochin it is about 154 mm.

The females attain sexual maturity at a size of 90-110 mm on the east coast and 130-150 mm on the west coast. The size at which 50% of the females become mature is 120 mm at Waltair and 138 mm at Madras when they are 9 months old while this value on the west coast is 160 mm (8 months) at Vizhinjam and 157 mm at Cochin.

Individuals with gonads in immature and maturing stages are also obtained during the entire fishing seasons.

Spawning

The data gathered from different centres during 1976-80 indicate that mature and spawning females occur in February, April, June, October and December in Cochin waters and January, March-April, September-October and December at Vizhinjam on the west coast. On the east coast, their occurrence is in January-February, April and September-December at Waltair, and almost throughout the year at Madras. Intensive spawning activity appears to take place during October-December and March-April along the west coast and in September-December, February and April-June on the east coast.

Spawning grounds of *Sepia pharaonis* have been reported to exist off Orissa and Visakhapatnam (FAO/UN, 1961) and egg capsules of this species have been collected from fishing grounds off Vizhinjam.

3.5.2.2. Adult history

Maximum size in the fishery

The maximum size of this cuttlefish observed in the commercial fishery was 334 mm in dorsal mantlelength on the west coast and 265 mm on the east coast. This species is the largest cuttlefish contributing to the cephalopod fishery in India.

Food

An active carnivore predating on fish and crustaceans, this species also feeds on cephalopods occasionally. Scales, eyeballs, otoliths and bones of fish, macerated and partly digested flesh and hard parts of crustaceans are the usual components of the stomach contents.

Growth

This cuttlefish grows to a size of 100 mm in 6 months and 165 mm in one year on the east coast; it is estimated that it takes about 16 months to reach a length of 197 mm. On the west coast, a higher growth rate is observed; at Vizhinjam it is estimated that a length of 138 mm is reached in 6 months, 211 mm in 12 months, 260 mm in 18 months and 294 mm in 24 months. To reach a size of 334 mm, the largest size observed in the fishery, it may take 36 months. The longevity thus appears to be upto about 2 years on the east coast and 3 years on the west coast.

3.6. **Sepia brevimana** Steenstrup

3.6.1. Distribution

This is a small sized cuttlefish of neretic habitat distributed in the Indian Ocean and the Western Pacific Ocean. In Indian waters it occurs in the fishery off Bombay on the west coast; Puri, Waltair and Madras on the east coast; and Port Blair, Andaman Islands.

Distribution of juveniles

Juveniles of the size range 20-40 mm at Waltair and 30-40 mm at Madras have been recorded in the trawl catches.

Distribution of adults

Adult cuttlefishes of the size range 45-95 mm occur in the trawl fishery off Madras and Waltair.

3.6.2. Bionomics and life-history

3.6.2.1. Reproduction

Sexuality

In addition to the hectocotylisation of the left ventral arm in the male, the shell is less broader and less acuminate and the tubercles on the dorsal surface of the shell are more prominent when compared to the shell of the female.

Sex ratio

On the Waltair Coast the males and females were in almost equal proportions during 1977, 1978 and 1980, but in 1976 and 1979, females were dominant (F 58 : M 42 and F 57 : M 43 respectively). In Madras, the females were numerically more except in 1979, when males slightly dominated (M 58 : F 42).

Maturity

The males mature within the size range of 45-89 mm with 50% of them attaining maturity at 56 mm at Madras and 62 mm at Waltair. The corresponding size range for females is 55-95 mm with 50% maturity at 63 mm and 59 mm respectively at the two centres. At these sizes the cuttlefishes are 11-13 months old.

Spawning

Mature individuals occur in waters off Madras and Waltair almost throughout the year. Spawning females were observed in January-February and July-December indicating a prolonged spawning period.

3.6.2.2. Adult history

Maximum size in the fishery

The maximum sizes of the species recorded in the landings at Waltair and Madras are 95 mm and 85 mm respectively.

Growth

This small sized squid attains a mantle length of 29-34 mm at the end of 6 months, 56-58 mm at the end of 12 months and 75-76 mm at the end of 18 months.

3.7. **Sepia elliptica** Hoyle

3.7.1. Distribution

This species is distributed in the neritic regions of the Indian Ocean and the Western Pacific. Its occurrence has been reported from Ganjam on the east coast of India and Cochin on the west coast.

Distribution of adults

Adult cuttlefish 70-129 mm in mantle length are obtained in trawl catches off Cochin where it forms a fishery throughout the year. This species is caught at depths of 30-40 m.

3.7.2. Bionomics and life-history

3.7.2.1. Reproduction

Sexuality

In males the left ventral arm is hectocotylised.

Sex ratio

The males were dominant during 1976 and 1979 (M 52 : F 48 and M 55 : F 45 respectively) but the females were numerically more than males in 1977 (F 56 : M 44), 1978 (F 58 : M 42) and 1980 (F 54 : M 46).

Maturity

Both males and females attain sexual maturity in the size range of 75-115 mm with 50% of them reaching mature stage at 93-96 mm.

Spawning

Mature males have been observed from October to June and in August and females from August to April and in June off Cochin. Spawning individuals have been noticed in the last quarter of the year.

3.7.2.2. Adult history

Maximum size in the fishery

The largest sizes of males and females recorded are 129 mm and 119 mm respectively.

3.8. **Sepia prashadi** Winckworth (Plate I)

3.8.1. Distribution

This species is distributed in the Indian Ocean : India, Mauritius, Madagascar, Gulf of Oman and Gulf of Suez. In India it has been recorded from Madras and Waltair on the east coast and Veraval on the west coast.

3.8.1.2. Bionomics and life-history

Cuttlefish ranging in size from 50 to 109 mm are obtained in the trawl nets operated off Waltair during the early months of the year and upto June and again from October to December in some years. They also appear in the trawl catches off Madras from January to April in some years. At both the places the species occur beyond 40 m. At Madras this particular species is caught in small quantities from January to April along with upwelled deeper water fishes such as *Psenes indicus* and *Priacanthus* sp.

3.9. **Sepiella inermis** (Ferussac and d'Orbigny)

3.9.1. Distribution

This is a small sized Indo-Pacific cuttlefish distributed widely in the Red Sea, India, Malaya and Indonesia to Vietnam. In India it occurs along the east and west coasts in shallow waters.

Distribution of juveniles

Juveniles ranging from very small size to 35 mm are commonly caught in indigenous gear such as shore seines and boat seines on the east coast, especially at Mandapam, Portonovo, Madras and Waltair.

Distribution of adults

The adult populations are distributed in shallow inshore waters upto about 40 m depth. Adults in the size

range 40–94 mm on the east coast and 55–124 mm on west coast are caught in trawl nets and other gears. The size of the cuttlefish is larger on the west coast measuring upto 124 mm while on the east coast the maximum size observed is 112 mm.

3.9.2. Bionomics and life-history

3.9.2.1. Reproduction

Sexuality

Sexual dimorphism is apparent in the external morphology. In males there is a row of small pale white patches along the fins at their base and this feature is very distinct in fresh specimens. The left ventral arm in the male is hectocotylised; at the basal portion of the arm the suckers are very minute and a series of transverse ridges and grooves are present. Males are smaller in size than the females.

Sex ratio

In Kakinada the sexes were almost equally represented. At Portonovo females were always dominant.

At Waltair the males dominated in 1976 and 1979 and in other years females were more dominant. The greatest variation was in 1977 when the ratio was F 70 : M 30. In Madras both the sexes were in equal proportion in 1979 while in all other years females dominated. In Cochin males were more in 1976, 1978 and 1979, while in 1977 and 1980 females outnumbered males with the ratio F 52 : M 48 and F 54 : M 46 respectively.

Maturity

Individuals in different stages of maturity are encountered throughout the year. The males and females attain maturity at a size of 45–105 mm, and the size at which 50% of the individuals mature is found to differ for two sexes at different centres. It is 53–56 mm for males at Waltair, Madras and Portonovo and 81 mm at Cochin; for females the size at 50% first maturity is 52 mm at Waltair, 61 mm at Madras, 50 mm at Portonovo and 83 mm at Cochin. It is estimated that the individuals of both the sexes mature when they are 9–12 months old on the east coast and about 18 months old on the west coast.

Spawning

Off Waltair spawning takes place in April, June to September and November to December. At Madras spawning is in February-March and from July to December with peaks in September, December and March. At Kakinada spawning individuals are encountered from April to November while at Portonovo it extends from March to October. On Cochin Coast, spawners occur in April and from September to December with peak spawning activity in September and October. Spawning takes place almost in inshore waters where egg capsules and juveniles are usually caught in fishing nets as at Madras and other centres.

3.9.2.2. Adult history

Maximum size in the fishery

On the east coast 112 mm is recorded as the maximum size of this cuttlefish in trawl landings whereas on the west coast it attains 124 mm.

Food

The food of this species mainly consists of fish and crustaceans; however, cephalopods also seem to be ingested to a very small extent.

Growth

Analysis of size frequency data shows that this species grows to a length of 29–35 mm in 6 months along the east coast. At the end of one year it reaches a size of 57 mm at Waltair, 53 mm at Kakinada, 60 mm at Madras and Portonovo and 61 mm at Cochin. The sizes attained at the end of 18 months is 73 mm at Waltair, 74 mm at Kakinada and 82 mm at Madras. On Cochin Coast this species lives longer and grows to 81 mm at the end of 1½ years and 101 mm at the end of 2 year. Females are larger than males.

4. SQUID AND CUTTLEFISH FISHERIES OF INDIA

4.1. Fishing craft and gear

The cephalopods are taken as a bye-catch of fish and prawns in many type of gear operated from a variety of craft. Apart from mechanisation of the craft which is on an increase in recent years, the fishing craft and gear used throughout the country are indigenous, operating in the inshore waters, designed to suit the sea conditions peculiar to each locality.

4.1.1. Fishing craft

Catamaran

This is probably the simplest form of a fishing craft and is used on the east coast from Orissa to Kanyakumari and part of South Kerala on the west coast (Anon. 1962). The catamaran is made of 3–5 logs of wood tied together in the fashion of a raft. Though the basic design is the same, the number and size of the logs vary in different areas. This is operated by 2–4 fishermen.

Canoes

There are many types of canoes operating along the west coast of India. The dug-out canoes, common on the Kerala and Karnataka Coasts, are made by scooping out the inner portion of a single log of wood. These canoes are 6.10–12.50 m long and from these 4–8 men operate gear like shore seines, boat seines, and gill nets. Apart from this type of craft, plank-built canoes, out-rigger

canoes and flat-bottom canoes are also in use in some areas. The use of outboard and inboard engines are catching up for canoes operating in Kerala.

Plank-built boats

Used in the northern part of both the coasts, this craft is very sturdy and is most suited for mechanisation without altering the design. Depending on the local operational requirements, various types of plank-built boats are indigenously evolved. They are of the size 6.5–13 m and are generally manned by 7–12 men.

Mechanised craft

The high returns from prawn fishery and the liberal aid given by Government agencies have provided great impetus to the pace of mechanisation of the fishing craft in the country. Over 18,000 mechanised boats have been constructed in the country which operate a wide variety of gears. Of these, trawlers which account for a substantial portion of the cephalopod landings, number more than 10,000. They are 6 to 13 m long and fitted with engines of 10–60 HP. About 60 steel trawlers (23 m upwards) with 90–300 or higher HP engines and refrigerated fish holds operate from our bases.

4.1.2. Fishing gear

Of the many types of gear that are in use at present, only the trawl nets and the traditional indigenous gears such as shore seines, boat seines, fixed bag nets (*dol* net) and hooks and line are the gear in which cephalopods are captured.

Shore seine

This is a beach seine operated in inshore waters on both the coasts. There are variations in the design and size like the *karavalai* or *periavalai* of the east coast and the large *rampani* of the west coast. This net is payed out from canoes or catamarans and dragged to the shore by groups of men. Squids and cuttlefishes of the shallow coastal waters are taken in this gear. In Ramanathapuram area on the southeast coast a special type of shore seine called *ola valai* is used to capture the squid *Sepioteuthis lessoniana*. In this net, split palmyrah leaves are tied to wings as flares to drive the squids into the net.

Boat seine

There are many kinds of boat seine that are used all along the coasts. They are conical bag-shaped nets without wings and are operated with the help of two canoes or catamarans. These nets are well suited to capture shoaling pelagic fishes. Fairly good quantities of squids come in this gear.

Fixed bagnets

This is a type of bag net widely used on the Gujarat and Maharashtra Coasts where it is called *dol* net. The size of the net varies considerably from 12 to 200 m in length. This net is operated by fixing it in water by means of stakes or buoys, where there are strong currents which help in keeping the net in horizontal position. The *dol* net is an important gear for prawns and Bombay-duck but squids are also caught in some quantities in Maharashtra.

Hooks and line

There are many types of hooks and line such as long line, hand line, etc. depending upon the number and size of hooks, length of line and the nature of the fish that are to be hooked. This gear is in use in many parts of the country, but cephalopods are caught mostly on Tamil Nadu and South Kerala Coasts. In Vizhinjam and neighbouring areas, a modified type of hand-line (hand jigs) is operated upto a depth of 35–40 m for capturing cuttlefish. In Mandapam area also the hand-jigs are used on a very small scale to hook the squid *Sepioteuthis lessoniana*.

Trawl nets

With the increase in mechanisation of the fishing craft, together with the high returns from prawn fishing, trawl nets have emerged as one of the most important gear in recent years especially along the west coast. Otter trawls which are the most common, vary in size with headline length of 7–27 m, depending upon the size of the trawler from which they are operated. The size and weight of the otter boards also vary according to the dimensions of the net and the towing power required. Several designs of trawls have been introduced during the last few years. Fourseam trawl, bulged belly trawl and out-rigger trawls are being increasingly used.

4.2. Trend of cephalopod fisheries

4.2.1. Cephalopod production of India

The estimated annual cephalopod production of India during 1978, 1979 and 1980 was 15,931 tonnes, 15,032 tonnes and 11,335 tonnes. The landings have increased to this level from catches as low as 349 tonnes in 1959 and 93 tonnes in 1961 and are the result of steady increase in effort over the years. Until 1973, the production did not exceed 1,700 tonnes and in 1974 there was a spurt in the catch and from then onwards, an increasing trend concomitant with the development of an export market for specially cuttlefish. The average triennial landings during 1978–80 show a rise by 7 times as compared to the landings in the triennium 1972–74 and 65 times those in the triennium 1960–62 (Fig. 2).

It is our assessment that the increase in production of squids and cuttlefishes seen after 1974 reflects to a very large extent the retention of a part of the by-catch in the trawl fishing for prawns. The bulk of the cuttlefish landings is from the prawn trawling grounds, and the earlier tendency among fishermen was to discard them to

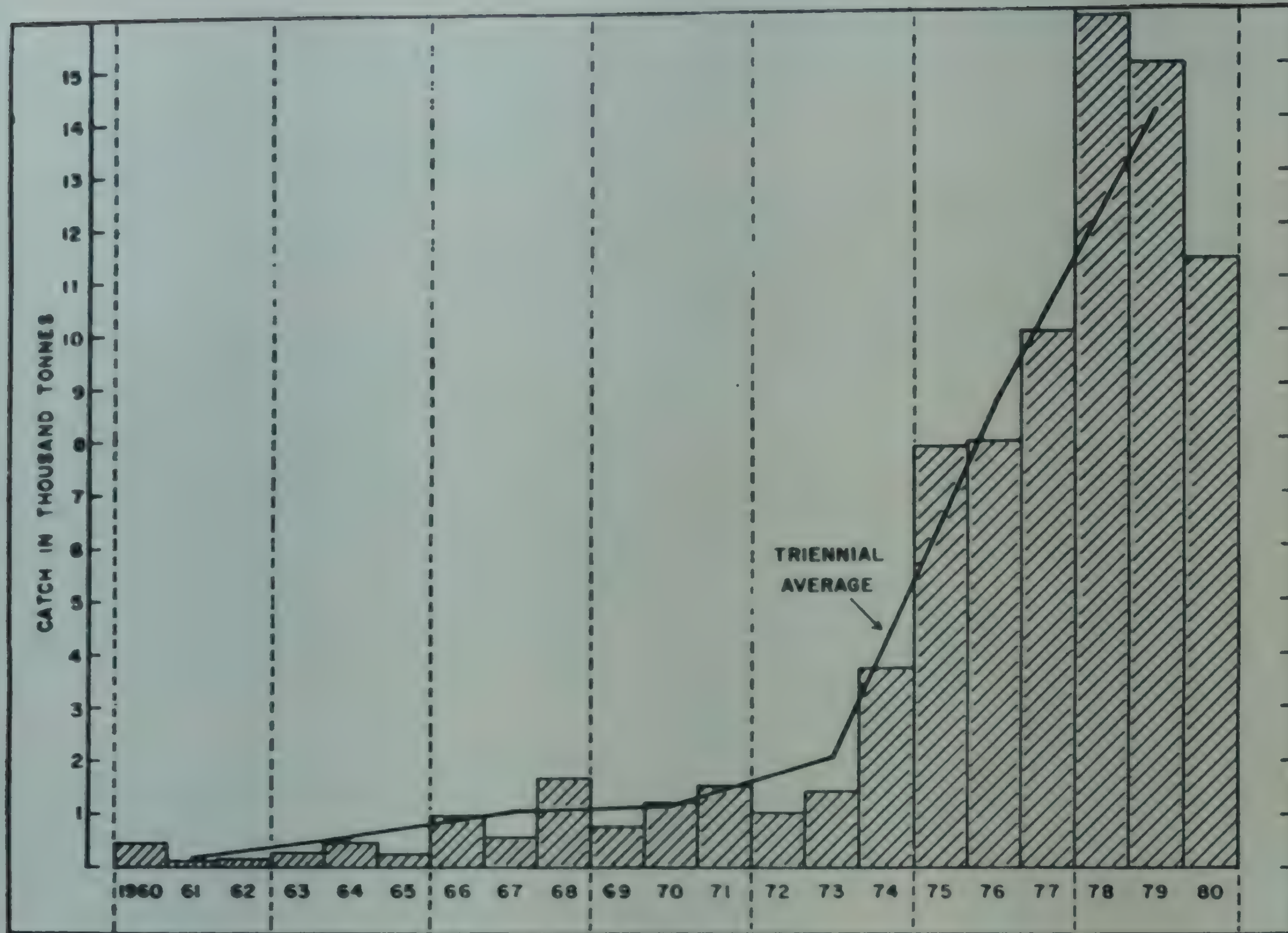

Fig. 2. Annual cephalopod landings and trend of triennial averages in India during 1960–80.

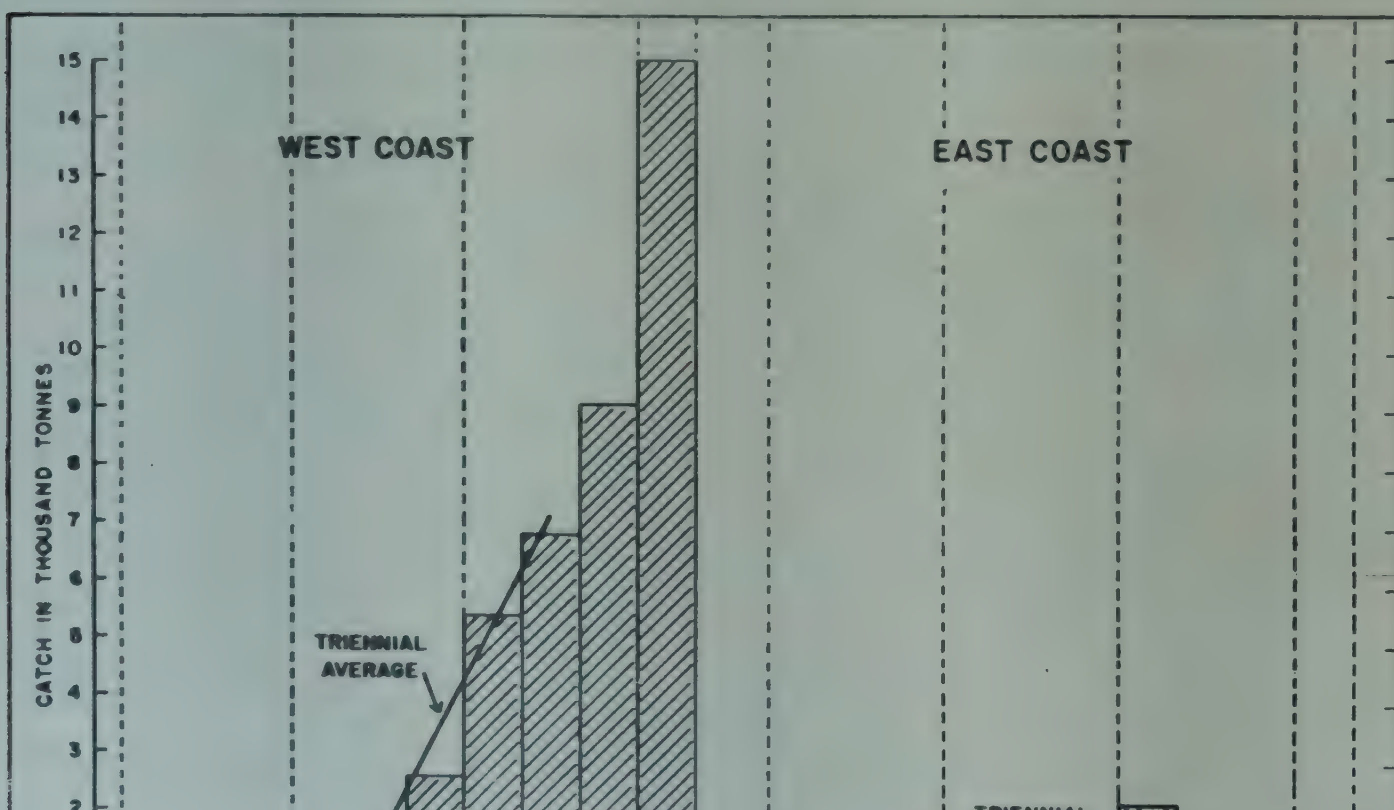

Fig. 3. Annual cephalopod landings and triennial averages along the west and east coasts of India during 1969–78.

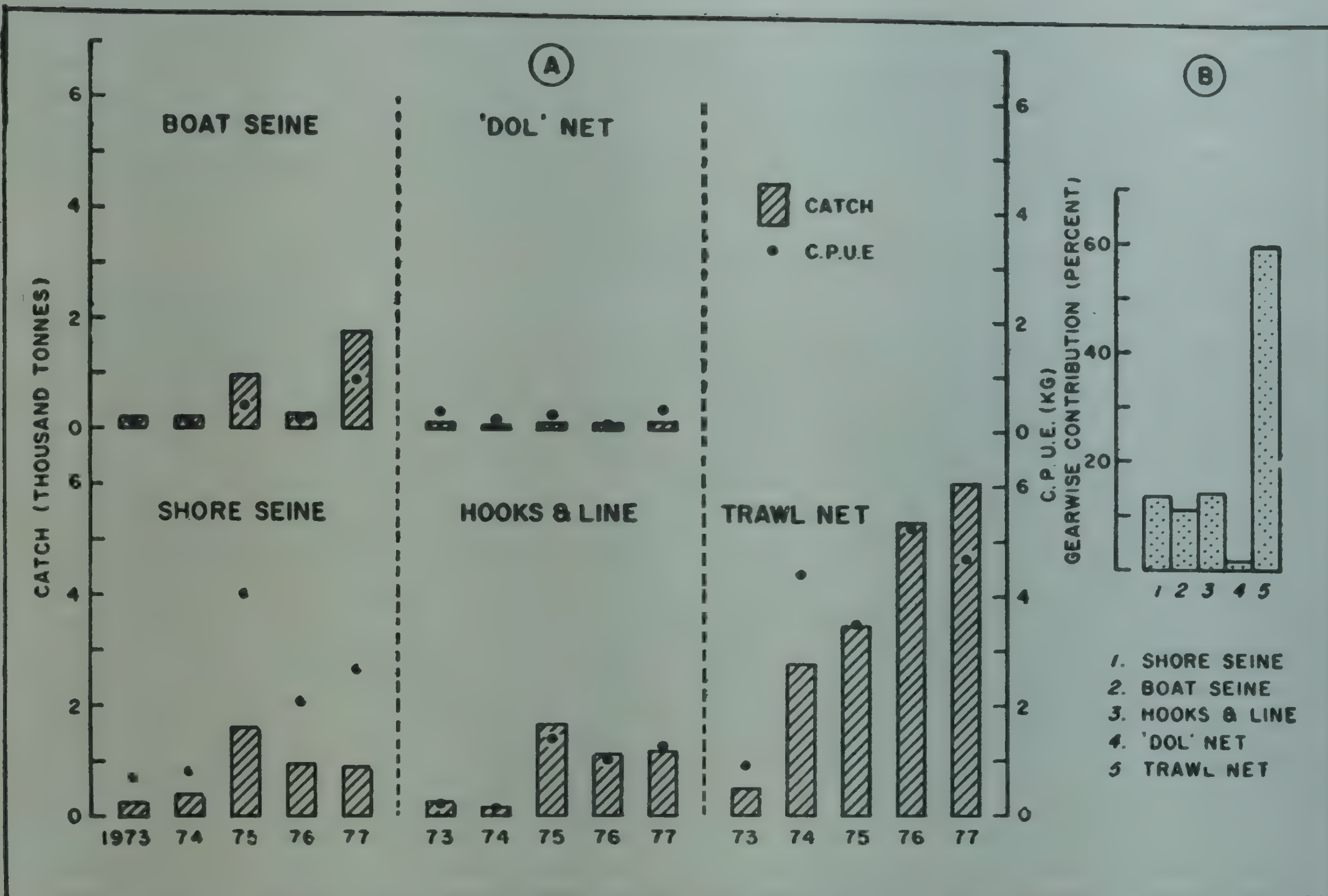

Fig. 4. Gearwise cephalopod landings in India during 1973–77. A. Catch and catch per unit effort. B. Percentage contribution by different gears.

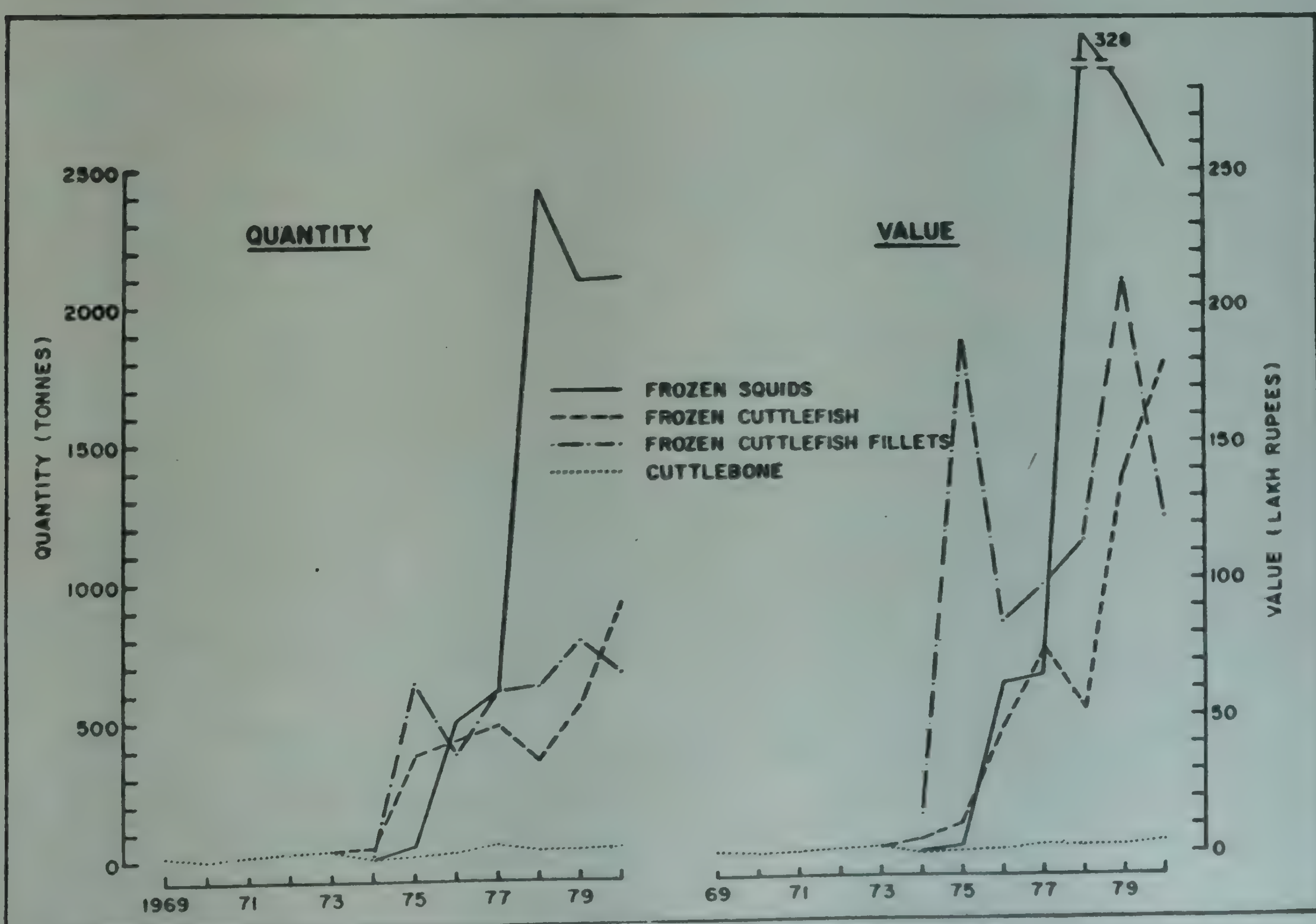

Fig. 5. Export of cephalopod products from India during 1969–80 (Source: M.P.E.D.A.).

the moment they are landed on the deck to prevent staining of prawn catch by the cuttlefish ink. Upto now no special fishery or effort is being expended specially for the capture of squids and cuttlefishes, except for the traditional subsistence fishing at Vizhinjam and Mandapam areas.

4.2.2. Cephalopod production on east and west coasts of India

The cephalopod landings along the east coast of India increased from 685 tonnes in 1970 to a peak of 2,292 tonnes in 1975 and later declined and stabilized at 915-960 tonnes during 1976-78. The landings along the east coast contributed 25 to 59% of the total cephalopod production of India in the period 1969-73 but in later years they accounted for only to 30%. The triennial average production during 1975-77 shows a three-fold rise over 1969-71 and there is fall in 1978 (Fig. 3). During 1973-77 more than half (56.6%) of the east coast cephalopod landings were obtained in trawl nets and the rest (43.4%) in non-mechanised gear of which shore seines accounted for 24.8%, boat-seines 15.5% and hooks and lines 3.1%.

The bulk of the cephalopod landings of India are taken from the west coast, the annual production constituting 41 to 94%. During 1969-73 the landings varied between 416 tonnes and 1056 tonnes and in the succeeding years there has been progressive rise with peak landings of 14,977 tonnes in 1978. Unlike on east coast there has been continuous increase in landings along the west coast. The average triennial landings in 1975-77 were 11 times those of in 1969-71 and those in 1978 were 23 times over 1969-71 (Fig. 3). On this coast 60.4% of the landings were obtained in trawl nets, 16.7% in hooks and lines, 10.1% in shore seines, 10% in boat seines and 3.7% in stake nets.

4.2.3. Cephalopod production in maritime States

Kerala, Maharashtra and since 1979 Gujarat are the leading States in cephalopod production, the three states together contributing 77% of the country's total cephalopod landings (Table 1). During 1977-80 the estimated annual catches of Kerala varied between 2,976 t and 4,973 t (20 to 50% in country's production), that of Maharashtra between 596 t and 4,557 t (6%-29%) and that of Gujarat between 1,439 and 5,351 t (14%-36%). Tamil Nadu ranked fourth with landings of 1,042 to 1,903 t (7-13%) in the same period. Karnataka's share of cephalopod production amounts to 68-1,346 t (0.5-8%). The rest of the landings come from Andhra, Goa, Pondicherry and other States.

4.2.4. Species comprising the fisheries

Four species of squids *Loligo duvaucelii* d'Orbigny, *Sepioteuthis lessoniana* Lesson, *Doryteuthis* sp. and *Loliolous investigatoris* Goodrich and seven species of cuttlefishes, *Sepia aculeata* Ferussac and d'Orbigny, *S. pharaonis* Ehrenberg, *S. brevimana* Steenstrup, *S. prashadi* Winckworth, *S. elliptica* Hoyle, *Sepiella inermis* (Ferussac and d'Orbigny) and *Euprymna stenodactyla* (Grant) occur in the neritic zone and form fisheries in India.

4.2.5. Gearwise landings

The analysis of the gearwise landings of cephalopods in the country during 1973-77 indicates that the major portion of the catch amounting to 60% comes in trawl nets, 14% in hooks and lines, 13% in shore seines, 11% in boat seines and 2% in *dol* nets (Fig. 4).

In shore seines 255 to 1,606 tonnes of cephalopods were obtained annually during the period 1973-77 with an average of 816 tonnes (Table 2). In the same period average annual landings of 337 tonnes and 295 tonnes are taken in this gear in Kerala and Tamil Nadu respectively, and in other states the catches were very low. The squids *Loligo duvaucelii*, *Sepioteuthis lessoniana*, *Doryteuthis* sp. and the cuttlefishes *Sepia aculeata*, *S. pharaonis* and *Sepiella inermis* are the component species of cephalopods obtained in this gear. In Ramanathapuram district on the southeast coast of India the squid *Sepioteuthis lessoniana* is caught in *Ola valai* (Rao, 1954).

Moderate catches of cephalopods amounting to an average of 387 tonnes and 225 tonnes in a year are obtained in boat seines in Kerala and Tamil Nadu, these two states accounting for almost the entire catch taken by this gear. *Loligo duvaucelii*, *Doryteuthis* sp. and *Loliolus investigatoris* among squids and *Sepiella inermis* among cuttlefishes are caught in this gear.

Though hooks and lines are operated in many parts of the east and west coasts of India, only in Vizhinjam (Kerala) and Kanyakumari and Colachel (Tamil Nadu) areas where modified hand lines (hand jigs) are used exclusively for cephalopods, especially cuttlefish. Of the annual average catch of 866 tonnes of cephalopods, the landings in Kerala amount to 456 tonnes and those in Tamil Nadu 409 tonnes. The species contributing to the fishery is the cuttlefish *Sepia pharaonis*; the squids *Loligo duvaucelii* and *Doryteuthis* sp. also are obtained occasionally. In Ramanathapuram District of Tamil Nadu hand jigs are used to a small extent to catch the squid *Sepioteuthis lessoniana*.

The fixed bag nets (*dol* nets) operated along the Maharashtra Coast take small fraction of the cephalopods landed in India. Though this gear is in operation in Gujarat also, no cephalopods are obtained there. In Maharashtra the annual average catch is slightly less than 100 tonnes. The species that are caught in this gear are *Loligo duvaucelii* and to a small extent *Sepiella inermis*.

Table 1. *Estimated cephalopod landings in maritime States of India (in tonnes)*

Years	West Bengal	Orissa	Andhra Pradesh	Tamil nadu	Pondicherry	Kerala	Karnataka	Goa	Maharastra	Gujarat	Andamans	Lakshadweep	Total landings of India
1959													349
1960	-	-	1	18	-	417	14	-	12	-	-	-	462
1961	6	-	-	5	-	28	1	-	53	-	-	-	93
1962	12	-	5	2	-	17	7	-	53	1	-	-	97
1963	1	-	10	29	-	180	13	-	27	-	-	-	260
1964	5	-	22	74	-	340	-	-	22	1	-	-	464
1965	-	-	-	82	-	174	1	-	7	1	-	-	265
1966	1	-	13	195	-	714	1	-	26	1	-	-	951
1967	-	-	4	140	-	374	-	-	2	1	-	-	521
1968	19	-	101	268	9	1,122	13	2	101	1	-	-	1,636
1969	2	-	70	293	25	164	57	-	147	1	-	10	769
1970	3	-	663	77	9	86	11	-	326	-	-	9	1,184
1971	89	-	114	389	52	473	7	-	368	-	-	13	1,505
1972	7	-	67	248	22	350	25	5	282	3	-	17	1,026
1973	7	-	61	426	20	339	19	-	501	1	-	20	1,394
1974	-	-	165	955	28	2,175	20	14	298	7	-	15	3,677
1975	2	-	151	2,953	58	3,342	175	96	482	611	-	19	7,889
1976	-	27	242	1,451	211	872	186	142	2,488	2,286	-	40	7,945
1977	-	-	408	1,375	62	4,973	965	164	596	1,439	-	23	10,005
1978	30	4	297	1,042	36	6,516	1,346	124	4,557	1,959	-	20	15,931
1979	-	14	523	1,903	50	2,976	68	173	3,959	5,351	-	15	15,032
1980	4	98	470	1,472	40	4,244	122	210	1,191	3,471	-	13	11,335

Table 2. *Gearwise cephalopod landings in India during 1973–77*

(Effort in number of units, catch in tonnes and C.P.U.E. in kg/unit/day)

Gear		1973	1974	1975	1976	1977	Average	Gearwise percentage of total cephalopod catch
SHORE SEINE	Effort	369,404	478,234	397,240	462,385	336,214	408,695	
	Catch	254.96	375.95	1,606.42	957.28	886.53	816.23	13.44
	C.P.U.E.	0.69	0.79	4.04	2.07	2.64	2.00	
BOAT SEINE	Effort	2,267,494	2,339,380	2,468,492	1,418,355	2,026,765	2,104,097	
	Catch	213.21	197.17	946.73	244.37	1,730.01	666.30	10.98
	C.P.U.E.	0.10	0.10	0.38	0.17	0.85	0.32	
HOOKS & LINE	Effort	1,231,434	1,107,657	1,161,869	1,135,497	915,481	1,110,388	
	Catch	255.19	155.13	1,630.38	1,127.04	1,162.69	866.09	14.26
	C.P.U.E.	0.21	0.14	1.40	1.00	1.27	0.78	
DOL NET	Effort	379,417	330,913	389,082	1,600,645	333,967	606,805	
	Catch	119.69	51.33	90.4[illegible]	108.62	124.07	98.83	1.62
	C.P.U.E.	0.32	0.16	0.23	0.07	0.37	0.16	
TRAWL NET	Effort	553,283	627,855	977,900	1,030,244	1,301,479	898,152	
	Catch	489.48	2,754.92	3,446.65	5,352.51	6,076.91	3,624.09	59.70
	C.P.U.E.	0.88	4.39	3.52	5.20	4.67	4.04	

The annual production from trawl fishing has increased remarkably from 489 tonnes in 1973 to 6,077 tonnes in 1977 with a rise in effort by 235% in the period (Table 2). The c.p.u.e. (catch per boat trip) has increased from 0.88 kg. in 1973 to 4.67 kg. in 1977. The squid *Loligo duvaucelii* and four species of cuttle fishes, viz. *Sepia aculeata*, *S. pharaonis*, *S. brevimana* and *Sepiella inermis* are the commercially important species fished in trawl nets. In addition species such as *Doryteuthis singhalensis* in small numbers in certain months are caught off Waltair and Madras. *Sepia prashadi* is landed occasionally on both the coast while *Sepia elliptica* forms a small fishery along the Cochin Coast. *Loligo duvaucelii* is fished throughout the year on both the coast, the peak fishing seasons being January to May at Bombay, January to March and August to October on the south west coast and April to May and August to November on the east coast. Good catches of *Sepia aculeata* are obtained from September to January on the west coast and January to June and September to November on the east coast. The best seasons for *Sepia pharaonis* are October to December on the west coast and March, June to August and November on the east coast.

4.2.6. *Off-shore fisheries*

Exploratory fishing conducted by large sized trawlers of Exploratory Fisheries Project, Government of India indicate that cephalopods are caught in appreciable quantities off Vishakhapatnam and Madras along the east coast and off Goa, Bombay and Gujarat along the west coast (Rao 1971; Anon. 1979). Squids and cuttlefish are obtained from shallow waters upto depths of 90 m on the east coast and 145 m on the west coast. The annual catch rates vary from 1 to 4 kg/hr at depths of 10–89 m off Waltair, from 1.5 to 9 kg/hr at depths of 20–109 m off Bombay and upto 10 kg/hr at 10–70 m off Goa. Recently good catches of cephalopods have been reported from Gujarat. The catch rates obtained off Gujarat at depths of 48–145 m are up to 139 kg/hr with the higher catches got in some areas like 21/68 and 22/68 at depths of 95/112 m in June-September 1979. The species netted by the trawlers are the squid *Loligo duvaucelii* and the cuttlefishes *Sepia aculeata*, *S. pharaonis*, *S. brevimana* and *Sepiella inermis*, the last two occurring in small quantities.

5. OCEANIC SQUIDS

The oceanic squids occurring in the Indian Ocean are *Symplectoteuthis oualaniensis*, *S. luminosa*, *Ommastrephes bartrami*, *Todarodes sagittatus angolensis* and *Notadarus sloani* (*gouldi?*) of the family Ommastrephidae, *Thysanoteuthis rhombus* of the family *Thysanoteuthidae*, and *Onychoteuthis banksi* of the family Onychoteuthidae have been recorded from the Indian Ocean (Filippova 1968). Many of these species are Indo-Pacific species which are commercially exploited in the Pacific Ocean by Japan (Clarke 1966; Voss 1973; Okutani 1977). *Symplectoteuthis oualaniensis* is most abundant and predominant species in the northern and central parts of the Indian Ocean and its southern boundary is limited to lat. 20° S. There is no quantitative information on the resources potential of the various species of oceanic squids in the Indian Ocean except for a few studies. Silas (1969) has recorded that *Symplectoteuthis oualaniensis* is fairly abundant on the continental shelf edge and slope off the west coast of India at depths beyond 180 m in Lat. 7°–14° N and Long. 72°–77° E. The squids were attracted towards the ship by lights and captured in drift nets. The Fishery Agency of Japan (1976, 1977) has reported the occurrence of *S. oualaniensis* at depths beyond 200 m in the Indian Ocean and Arabian Sea between Lat. 4° S and 25° N and Long. 61°–67° E in oxygen deficient layers. There is need to survey the oceanic areas of Indian Ocean for exploiting them.

6. EXPORT OF CEPHALOPODS

Quantity and value

The growth of export of cephalopod products from India has been spectacular. The trade which stood at 421 kg valued at Rs. 11,000 in 1963, and 11 tonnes of cuttlebones worth Rs. 74,000 in 1969 has reached an all-time high of 3,818 tonnes valued at Rs. 55.8 millions in 1980 (Fig. 5). Upto 1974 the upward trend in export has been gradual but from 1975 onwards there is a steep rise both in quantity and value.

Products of export

The products of cephalopods that are exported from India are frozen squids, frozen cuttlefish, frozen cuttlefish fillets and cuttlebones. In 1980 the frozen squid was the predominant item forming 57% and the cuttlefish products account for the rest.

Frozen squids

The first export of frozen squid was to Australia in 1974 with 0.5 tonne and subsequently there has been very good demand for this product in several countries. In 1980 the export was 2,179 tonnes worth Rs. 25 millions which is less than that in 1978 (2,428 tonnes and Rs. 32.8 millions). Among over a dozen countries that import Indian frozen squid the major importers are the U.A.E., France, the Netherlands, Greece, Belgium and Algeria.

Frozen cuttlefish fillets

Among cephalopod products frozen cuttlefish fillets fetch the highest price. During the period 1974–75 the annual export of frozen cuttlefish fillets ranged between 92.6 tonnes (Rs. 1.46 millions) in 1974 and 788 tonnes (Rs. 21 millions) in 1979. After a good export in 1975, there has been a decline in the subsequent years till it recovered in 1979. In 1979 more than 516 tonnes (over

65%) of fillets were exported to Japan realising Rs. 16.5 millions (78%). All through the years Japan had been the major importer of Indian frozen cuttlefish but in 1980 France was the largest buyer, taking 381 tonnes (56%) valued at Rs. 5.6 millions. Other buyers include Belgium, Hongkong, the Netherlands, Italy and U.S.A.

Frozen cuttlefish

From 1973 onwards this product is being exported. The total annual export varied from 13 tonnes in 1973 to 926 tonnes valued at Rs. 17.9 millions in 1980. There has been steady increase in exports except in 1976 and 1978 when there has been a decline both in quantity and value. The largest single importer is Japan which lifted 381 tonnes valued at Rs. 11 millions. The other countries include Algeria, France, Italy, the Netherlands, U.K., Spain, Belgium, U.S.A. and Kuwait.

Cuttlebones

The cuttlebones have been among the export commodities much earlier than other cephalopod products. In 1980 a total of 36 tonnes of cuttlebones were exported realising an earning of Rs. 0.4 million. Though this is being exported to over a dozen countries including Canada, New Zealand, Saudi Arabia, Federal Republic of Germany, Thailand, U.K., and U.S.A. offer a steady market from 1969 onwards (Source : M.P.E.D.A., Cochin).

7. CONSTRAINTS

One of the constraints for the development of the cephalopod fishery has been the general tendency to discard at sea squids and cuttlefishes occurring as bye-catch. They form a sizable bye-catch in the shrimp trawling grounds and the present trend of bringing part of the bye-catch ashore is on account of the recent growth of an export market. It is unlikely that production could be increased using existing methods of fishing except through saving all that comes in as bye-catch. Squid jigging, light fishing, mid-water trawling and encircling nets have to be developed to suit the conditions in Indian waters. Exploratory fishing should also be conducted in the deeper neritic waters for the assessment of resources of known and additional species. This will involve expansion of commercial fishing using larger vessels. A more streamlined system of estimation of squid and cuttlefish landings from traditional fishing grounds as well as data on component species are needed. It is essential that the catch data are also collected for small sized cephalopods of genera such as *Euprymna* and *Loliolus*.

There are many lacunae in the knowledge of the biology of squids and cuttlefishes of the tropical waters and therefore a concerted effort has to be made to study the commercially important species.

Post-harvest technology is a major area where attention and improvements are necessary, especially for promoting exports. The better utilisation of residual materials after processing, such as heads and arms, and cuttlebones has to be attempted.

In 1980 there was a fall in the export trade of cephalopod products which was immediately reflected in a decline of their catches as part of the catch was discarded at sea due to a lack of market demand. Due to some temporary setback in procurement for processing, a tendency to discard a portion of the catches at sea may again arise. To avoid such a situation a steady local market has to be developed to take in additional catches. At present only a small section of the coastal populations consumes cephalopods. Therefore, there is an urgent need to popularise squid and cuttlefish as food through a well planned extension programme.

8. PRODUCTION POTENTIAL AND PROSPECTS

There are no proper estimates of exploitable yield of cephalopods from the continental shelf of India based on resource data. Based on present production, some workers have forecast the yield potential of the shelf areas of the Indian Ocean. Gulland (1970) has stated that the production from the Indian Ocean could be several hundreds of thousands of tonnes. Voss (1973) estimated the production potential of the region to be 500,000 tonnes. Yet another estimate of the production potential is 200,000 tonnes (Anon. 1977). George *et al.* (1977) have in passing mentioned the exploitable production from the continental shelf waters of India to be around 180,000 tonnes of which 55% is to come from the upper east coast, 11% each from lower east coast and north west coast and 20% from the south west coast. These figures are very arbitrary.

The progressive rise in yearly cuttlefish landings obtained as bye-catch of shrimp trawlers clearly indicate that there are extensive cuttlefish resources of the species *Sepia aculeata*, *S. pharaonis*, *S. brevimana* and *Sepiella inermis* in the outer shelf waters particularly at depths of 25 to 75 m. Among squids, *Loligo duvaucelii* is commercially important, occurring along both east and west coasts, while *Doryteuthis* sp. is caught in good quantities along the southern Kerala Coast. At present, the inshore fishery of *Sepioteuthis lessoniana* is not actively persued on the southeast coast. Efforts have to be made to revive the fishery. There are very good possibilities for stepping up squid as well as cuttlefish production from the neretic waters of India by adopting suitable fishing methods and increasing effort.

Until now the oceanic cephalopod resources of the Indian Ocean have not been exploited by India. Studies conducted so far show that *Symplectoteuthis oualaniensis* is common in the oceanic waters. The

occurrence of larvae and juveniles of oceanic squids in various parts of the Indian Ocean and the indirect evidence of occurrence of adult squids from the presence of beaks and other remains of squids in the stomachs of Cetaceans are indicators of the large scale distribution of squids in the Indian Ocean. A beginning has to be made in the exploitation of oceanic squids by developing and using appropriate methods of fishing. There are also rich fishing grounds of cuttlefish *Sepia pharaonis* in the Arabian Sea. Exploratory fishing programmes to chart the distribution of this species and oceanic squids are also to be undertaken in this connection. Japan and Taiwan are exploiting *Symplectoteuthis oualaniensis* found off Okinawa and Taiwan in the Pacific Ocean (Okutani 1977). India could similarly develop a fishery for this resource in the Indian Ocean which has not been hitherto exploited.

Thus, it will be seen that we have only an indicative idea of the resources of squids available from our deep neretic and oceanic waters. This is an area which will need a feasibility study of working out an effective operational method for harvesting the resources. We will also need expertise in the operational side of fishing as squid jigging has never been carried out in this country. These constraints and prospects may be taken into consideration for planning a rational development programme for squid and cuttlefish fishery in India.

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BOOKS

Fisheries Oceanography and Ecology: By Taivo Laevastu and Murray L Hayes, Fishing News Book Ltd. England, pp 199, 1981.

This is the third revised edition of a book summarizing the knowledge of the relations between fish and its ocean environment published by the same publisher. This book summarizes in a semi-popular manner the principal results of research in the field of fisheries oceanography during the last eight decades. It also shows how to apply facts and principles of oceanography and marine mateorology to fisheries problems. Emphasis has been placed on the description of subjects where the interest of biologists and oceanographers must cross. These subjects are especially illustrated in the summery reviews on fish behaviour and fishery resources. Brief reviews are given of ocean analysis and forecasting and of possible fisheries diagnostic and prognostic services. Some background of modern fisheries management on the basis of ecosystem approach is given. Even though it is primarily meant for fisheries biologists, it will be easily understandable by and useful to skippers and administrators in the fisheries industries.

Energy at the surface of the earth : By David H. Miller, Academic Press. London, pp 516, 1981.

This is the 27th volume in International Geophysics Series. It presents one way of looking at the manner in which the biological, physical and cultural system that mantle the landmasses of our planet receive, transform, and give off energy, which is an essential condition of existance that takes many forms. The principal forms of energy that are converted at the ecosystem scale include radiant, latent, mechnical, chemical, fossil and thermal. The author starts with radiant energy absorbed by ecosystems, a phenomenon that is independent of their surface temperature and that can be looked on as a burden or a gift depending on circumstances. The temperature dependent flumes of energy are discussed. The final chapters deal with vertical stratification and areal contrasts in energy budgets.

Man and Fisheries on an Amazon Frontier : By Michael Goulding, Dr. W. Junk Publishers. The Hague, pp. 137, 1981.

This book represents an attempt to describe and quantify the nature of the Rio Madeira fisheries within the framework of the Rondonia frontier. The author investigated for five years the fish ecology, fisheries and human geography of the region to understand the Rio Madeira as a whole to elucidate the natural history of the region as part of the larger Amazon basin. This work will serve as a trial run for a much larger treatise that will deal with all the Amazon basin and its aquatic resources. The book starts with physical, biological and cultural portraits of the Rio Madeira valley followed by the discussion of commercial fisheries found in the region. The next chapter gives quantitative data in terms of fishing effort and yield followed by an overview of the natural history of the Rio Madeira food fishes, and each of the species is discussed in some detail, accompanied by a photograph. The final chapter views the problems and prospects of the Rio Madeira fisheries.

Compiled and prepared by M. J. George & G. Subbaraju.

Published by Dr. M. J. George, Senior Scientist on behalf of the Director, Central Marine Fisheries Research Institute, Cochin-682 018 and printed at PAICO, Cochin.

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3. Books.

Cover photo: A collection of *Penaeus canaliculatus*, locally known as 'O.B - Zebra'.

SYNOPSIS OF MARINE PRAWN FISHERY OF INDIA – 1980 *

Total production

During the year 1980 the total marine prawn production was estimated at 1,70,737 tonnes against 1,77,582 t in the previous year (Table 1), showing a decrease of 6,845 t (3.85%). A comparative study of the production over the past few years indicates that the trend of slight decrease from the maximum in 1975 is maintained over these years. The decrease this year is mostly brought about by reduced catches in Maharashtra State.

Considering the production of the penaeid prawns and nonpenaeid prawns separately, the same trend of slight decrease in 1980 is noticed in both categories (Table 3). During 1980 the penaeid prawn catch recorded a reduction of 1,628 t (1.43%) and the non-penaeids a decrease of 5,217 t (8.16%). The decrease in catches of both nonpenaeids and penaeids in Maharashtra State is to a certain extent compensated by the increased production of penaeids in Kerala State.

In the monthly landings of prawns (Table 4) as in previous year the minimum of 8,361 t is recorded in June and the maximum of 30,868 t in July which is more than double that of July 1979. This is mainly due to the revival of the penaeid prawn fishery of Neendakara area of Kerala coast this year in the monsoon months. During the south-west monsoon months the catches were poor in the states of Maharashtra and Gujarat while Tamil Nadu and Andhra Pradesh showed better catches. The north west coast states landed better catches in the first and last quarters of the year.

The statewise production of prawns this year also shows the maximum of 41.4% in Maharashtra, although much less than the percentage in last year, namely 57.4. The percentage contribution of Kerala State registered cosiderable increase, showing 31.8% of the total production (Table 1). The statewise and monthwise landings of penaeid and nonpenaeid prawns (Tables 5 and 6) indicate that penaeid prawns contribute to major part of the fishery in Karnataka, Pondicherry, Orissa and Kerala. The entire fishery of Goa and Andamans is contributed by penaeid prawns. Larger portion of the fishery in Tamil Nadu also is contributed by penaeids. In Maharashtra 66.8% of the total catch was nonpenaeid prawns with the maximum in the months of May, January and December. In Andhra Pradesh and Gujarat the nonpenaeid prawns contributed to 43.4% and 22.1% of the catches respectively. Maximum catches of nonpenaeid prawns in Andhra Pradesh are in July and August. In the case of penaeid prawns July, August registered maximum catches in Kerala and September–November period in Maharashtra. In several states minimum catches of penaeid prawns are landed in the south west monsoon months.

In the overall species composition (Table 2) *Parapenaeopsis stylifera* ranked first (29.8%) as against *Acetes indicus* of the previous year which has been relegated to a second position this year. This was mainly due to the heavy landings of the former species along the coasts of Kerala from where alone an equal amount of the total landings of the species recorded for the previous year was obtained. In the case of the sergestid shrimp, the overall production as well as percentage showed marginal improvement over that of the previous year. The other major species in the order of their abundance were *Metapenaeus dobsoni*, *Nematopalaemon tenuipes*, *Penaeus indicus*, *M. affinis*, *Solenocera crassicornis* and *M. monoceros* which collectively accounted for 31.5% of the total production. While the fishery showed improvement in respect of species such as *M. dobsoni*, *P. indicus* and *M. monoceros* this year, considerable decline in catch was noticed in the case of *N. tenuipes*, *M. affinis* and *S. crassicornis* over that of the previous year. Among the three dominant species mentioned above *P. stylifera* was mostly harvested from the coasts of Kerala, Maharashtra, Gujarat and Karnataka, *A. indicus* from Maharashtra and Gujarat and *M. dobsoni* from Kerala, Karnataka and Tamil Nadu. The annual percentage distribution of important species at different observation centres during 1980 is shown in Table 7.

Gearwise production

Shrimp trawls operated by small and medium sized vessels continued to be the major gear employed for the exploitation of prawns. When compared with the previous year there has been a decline to the tune of about 18% in the total trawler trips operated in the fishery of this year, mainly brought about by the reduced fishing input along the coasts of Maharashtra, Karnataka, Tamil Nadu and Andhra Pradesh. Of the total catch of 1,70,737 t of prawns landed during this year 87,956 t were contributed by the trawlers forming 51.5% and the rest by the indigenous gears such as fixed bag nets, gill-nets, seines and others. While most of the states recorded lower production of prawns in shrimp trawls, Gujarat and Kerala witnessed considerable improvement in the

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* Prepared by Crustacean Fisheries Resources team

Table 1. *Statewise prawn landings and percentage contributions during 1980 and 1979*

Maritime States	Prawn landings in tonnes 1980	Prawn landings in tonnes 1979	Percentage 1980	Percentage 1979
Gujarat	18,590	11,953	10.8	6.7
Maharashtra	70,742	1,01,846	41.4	57.4
Goa	1,853	1,594	1.0	0.9
Karnataka	3,226	4,660	1.8	2.6
Kerala	54,375	29,597	31.8	16.7
Tamil Nadu	10,028	11,119	5.8	6.3
Pondicherry	527	604	0.3	0.3
Andhra Pradesh	10,006	11,814	5.8	6.7
Orissa	1,104	3,017	0.6	1.7
West Bengal	200	571	0.1	0.3
Andamans	54	64	-	-
Larger trawlers	32	743	-	0.4
All India Total	1,70,737	1,77,582	100	100

Table 2. *Species wise break-up of prawn landings and percentages during 1980*

Species	All India landings in tonnes	Percentage
Solenocera crassicornis	6,388.5	3.7
Penaeus indicus	10,298.2	6.0
P. merguiensis	495.9	0.3
P. monodon	2,655.8	1.6
P. semisulcatus	1,712.5	1.0
P. penicillatus	932.8	0.6
Metapenaeus dobsoni	18,998.1	11.1
M. affinis	7,231.7	4.2
M. monoceros	5,607.9	3.3
M. brevicornis	835.7	0.5
M. kutchensis	1,534.9	0.9
Parapenaeopsis stylifera	50,829.0	29.8
P. hardwickii	2,214.0	1.3
Acetes indicus	41,282.4	24.2
Nematopalaemon tenuipes	12,653.7	7.4
Exopalaemon styliferus	1,276.9	0.7
Exhippolysmata ensirostris	3,091.5	1.8
Other species	2,697.5	1.6
Total	1,70,737.0	100.0

Table 3. *Statewise penaeid and non-penaeid prawn landings and their percentage for 1980 and 1979*

Maritime States	Landings in tonnes and percentage							
	1980				1979			
	Penaeid		Non-penaeid		Penaeid		Non-penaeid	
	Catch	%	Catch	%	Catch	%	Catch	%
Gujarat	14,481	12.9	4,109	7.0	8,606	7.6	3,347	5.2
Maharashtra	23,433	20.9	47,309	80.5	45,638	40.2	56,208	87.9
Goa	1,853	1.6	-	-	1,594	1.4	-	-
Karnataka	3,098	2.7	128	0.2	4,654	4.1	6	-
Kerala	52,633	46.9	1,742	2.9	29,522	26.0	75	0.1
Tamil Nadu	9,082	8.1	946	1.6	10,222	9.0	897	1.4
Pondicherry	485	0.4	42	-	532	0.5	72	0.1
Andhra Pradesh	5,660	5.0	4,346	7.4	8,697	7.6	3,117	4.9
Orissa	1,074	0.9	30	-	2,983	2.6	34	-
West Bengal	152	0.1	48	-	410	0.4	161	0.3
Andamans	54	-	-	-	64	-	-	-
Larger Trawlers	32	-	-	-	743	0.6	-	-
All India total	1,12,037	100	58,700	100	1,13,665	100	63,917	100

catches over those of the previous year. A noteworthy feature observed in the fishery of Kerala is that although the trawl fishery suffered a set back in the previous year as a result of low production of 'Karikkadi' (*Parapenaeopsis stylifera*) at Neendakara (Sakthikulangara) it revived considerably this year with nearly two-fold increase in the landings brought about by the successful monsoon fishery of this centre. The statewise percentage contributions of the annual trawler catch of this year as well as the previous year (in parenthesis) were: Kerala - 52.4 (30.3), Maharashtra - 17.1 (37.1), Gujarat - 11.7 (6.5), Tamil Nadu - 7.3 (9.4), Andhra Pradesh - 4.4 (6.1), Karnataka - 3.4 (4.9), Goa - 2.0 (1.8), Orissa - 1.0 (2.5) and Pondicherry - 0.4 (0.5).

The trend of prawn landings by commercial shrimp trawlers which accounted for the bulk of the penaeid prawns of the country, in relation to effort and the total prawn catch, is depicted in Fig. 1. In the total prawn landings these nets accounted for the major share in Karnataka (94.7%), Goa (92.1%), Kerala (84.8%), Pondicherry (81.4%), Orissa (76.3%), Tamil Nadu (64.1%) and Gujarat (55.4%). Their contributions in Maharashtra (21.3%) and Andhra Pradesh (38.8%) were relatively very low. The peak landings were recorded during February in Goa, March in Orissa, May and August in Andhra Pradesh, June in Tamil Nadu and Pondicherry, July and August in Kerala, September in Karnataka and October to December in Gujarat and Maharashtra. Landings by the indigenous gears accounted for the bulk of the prawn catch in Maharashtra (Fixed bag nets) and Andhra Pradesh (Seines).

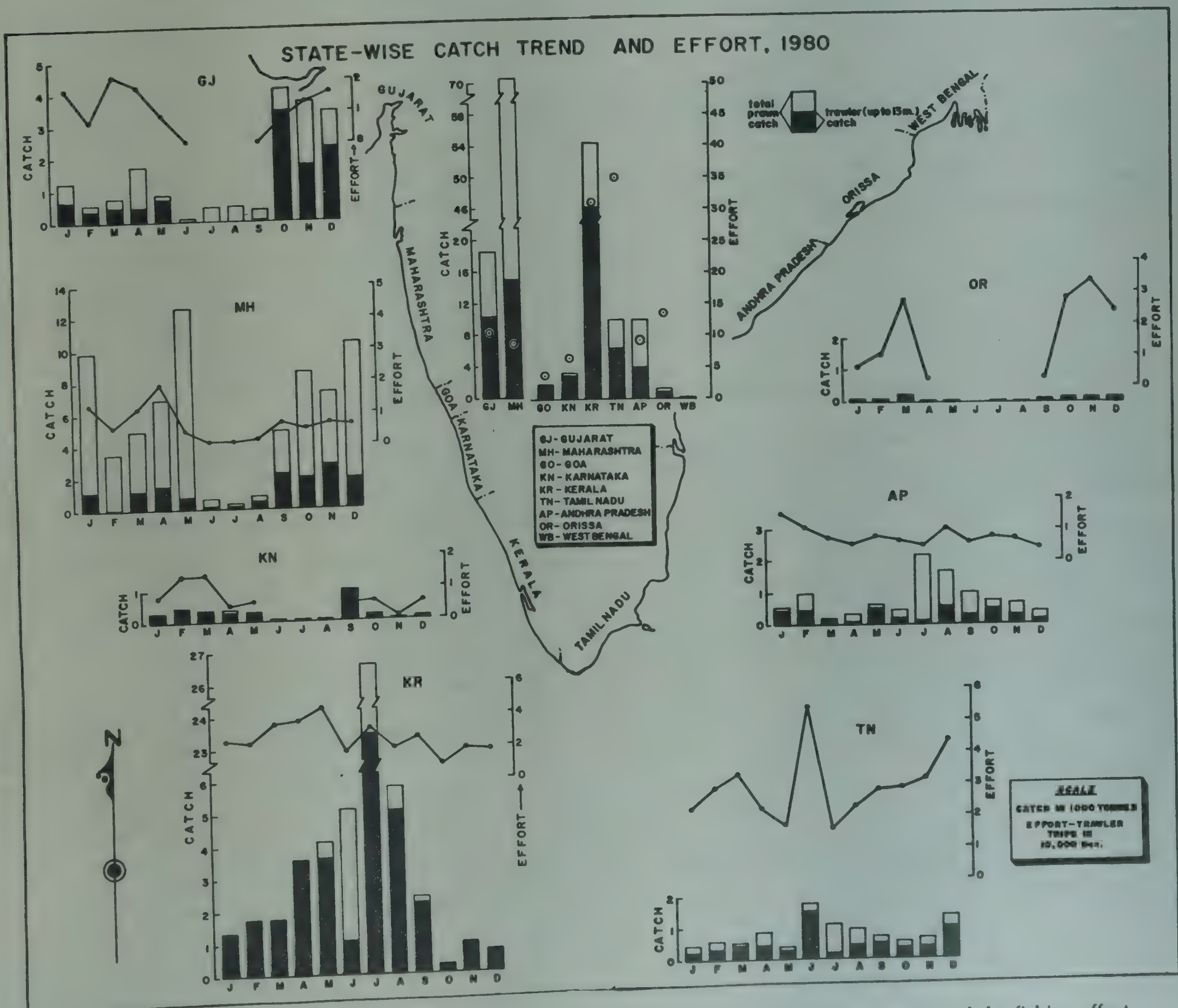

Fig. 1. Prawn landings by commercial shrimp trawlers in relation to the total prawn catch and the fishing effort during 1980.

Table 4. *Monthly prawn landings in different maritime states during 1980*

Maritime States	Prawn catch in tonnes												EFP/ Larger Trawlers	Total for 1980
	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.		
Gujarat	1,269	611	738	2,039	839	127	486	484	422	4,205	3,818	3,552	–	18,590
Maharashtra	9,895	3,548	4,887	6,886	12,551	654	366	831	4,866	8,574	7,325	10,359	–	70,742
Goa	245	546	258	169	166	8	1	111	80	74	40	155	–	1,853
Karnataka	312	472	389	337	302	24	24	41	988	180	24	131	2	3,226
Kerala	1,376	1,752	1,740	3,592	4,103	5,138	26,599	5,803	2,348	285	944	695	–	54,375
Tamil Nadu	434	635	562	849	416	1,725	1,159	979	734	544	640	1,351	–	10,028
Pondicherry	22	42	38	5	39	254	12	18	27	10	23	37	–	527
Andhra Pradesh	554	1,028	205	388	663	427	2,197	1,648	1,000	751	631	394	120	10,006
Orissa	92	115	262	37	40	–	20	2	105	132	160	139	–	1,104
West Bengal	188	–	12	–	–	–	–	–	–	–	–	–	–	200
Andamans	4	5	7	4	5	4	4	4	5	4	4	4	–	54
Larger trawlers	–	–	–	–	–	–	–	–	–	–	–	–	32	32
All India total	14,391	8,754	9,098	14,306	19,124	8,361	30,868	9,921	10,575	14,759	13,609	16,817	154	1,70,737
Month wise percentage	8.4	5.1	5.3	8.3	11.2	4.9	18.0	5.8	6.2	8.6	7.9	9.8		

Table 5. *Penaeid prawn landings in different maritime states during 1980*

Maritime states	Prawn catch in tonnes												EFP/ Larger Trawlers	Total for 1980
	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.		
Gujarat	712	581	514	854	523	122	410	484	371	3,846	3,461	2,603	–	14,481
Maharashtra	1,659	1,121	1,557	2,482	1,002	110	196	704	4,003	4,054	3,859	2,686	–	23,433
Goa	245	546	258	169	166	8	1	111	80	74	40	155	–	1,853
Karnataka	312	367	389	336	286	24	24	41	984	179	24	131	1	3,098
Kerala	1,373	1,737	1,729	3,526	4,103	4,762	25,376	5,770	2,348	285	944	680	–	52,633
Tamil Nadu	424	632	506	797	381	1,687	542	964	721	508	586	1,334	–	9,082
Pondicherry	22	42	24	5	31	251	12	18	27	10	23	20	–	485
Andhra Pradesh	518	968	175	104	411	299	278	772	682	622	321	390	120	5,660
Orissa	90	99	260	27	40	–	20	2	105	132	160	139	–	1,074
West Bengal	152	–	–	–	–	–	–	–	–	–	–	–	–	152
Andamans	4	5	7	4	5	4	4	4	5	4	4	4	–	54
Larger Trawlers	–	–	–	–	–	–	–	–	–	–	–	–	32	32
All India total	5,511	6,098	5,419	8,304	6,948	7,267	26,863	8,870	9,326	9,714	9,422	8,142	153	1,12,037
Month wise percentage	4.9	5.4	4.8	7.4	6.2	6.5	23.9	7.9	8.3	8.7	8.4	7.3		

Table 6. *Non-penaeid prawn landings in different maritime states during 1980*

Maritime States	Prawn catch in tonnes												EFP/ Larger Trawlers	Total for 1980
	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.		
Gujarat	557	30	224	1,185	316	5	76	–	51	359	357	949	–	4,109
Maharashtra	8,236	2,427	3,330	4,404	11,549	544	170	127	863	4,520	3,466	7,673	–	47,309
Goa	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Karnataka	–	105	–	1	16	–	–	–	4	1	–	–	1	128
Kerala	3	15	11	66	–	376	1,223	33	–	–	–	15	–	1,742
Tamil Nadu	10	3	56	52	35	38	617	15	13	36	54	17	–	946
Pondicherry	–	–	14	–	8	3	–	–	–	–	–	17	–	42
Andhra Pradesh	36	60	30	284	252	128	1,919	876	318	219	310	4	–	4,346
Orissa	2	16	2	10	–	–	–	–	–	–	–	–	–	30
West Bengal	36	–	12	–	–	–	–	–	–	–	–	–	–	48
Andamans	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Larger Trawlers	–	–	–	–	–	–	–	–	–	–	–	–	–	–
All India total	8,880	2,656	3,679	6,002	12,176	1,094	4,005	1,051	1,249	5,045	4,187	8,675	1	58,700
Month wise percentage	15.1	4.5	6.2	10.2	20.7	1.8	6.8	1.8	2.1	8.6	7.1	14.8		

Table 7. *Annual percentage distribution of important species in the prawn landings at different centres during 1980*

Penaeids

Centres	*S. crassicornis*	*P. indicus*	*P. monodon*	*P. semisulcatus*	*P. merguiensis*	*M. dobsoni*	*M. affinis*	*M. monoceros*	*M. brevicornis*	*M. kutchensis*	*P. stylifera*	*P. hardwickii*
Veraval	17.4	–	–	–	–	–	4.6	5.1	–	10.6	44.7	10.4
Bombay	15.3	–	–	–	–	–	21.6	5.6	1.0	–	51.2	2.8
Karwar	–	1.9	–	–	–	25.4	6.0	20.4	–	–	46.2	–
Mangalore	–	7.8	0.7	–	–	49.4	6.1	6.1	–	–	29.8	–
Calicut	–	14.9	–	–	–	25.8	–	2.9	–	–	56.3	–
Cochin	–	18.1	–	–	–	59.6	0.7	–	–	–	21.6	–
Neendakara	–	3.3	–	–	–	3.2	1.2	0.9	–	–	91.0	–
Madras	–	29.8	20.2	17.9	–	16.6	–	15.5	–	–	–	–
Kakinada	–	9.4	7.9	–	–	12.8	7.8	15.5	10.3	–	10.6	–
Puri	–	30.1	–	–	57.8	–	12.1	–	–	–	–	–

Non-penaeids

	A. indicus	*E. styliferus*	*N. tenuipes*	*E. ensirostris*
Veraval	67.2	–	23.1	9.7
Bombay	73.4	–	22.9	3.7
Kakinada	24.6	36.4	14.7	24.3

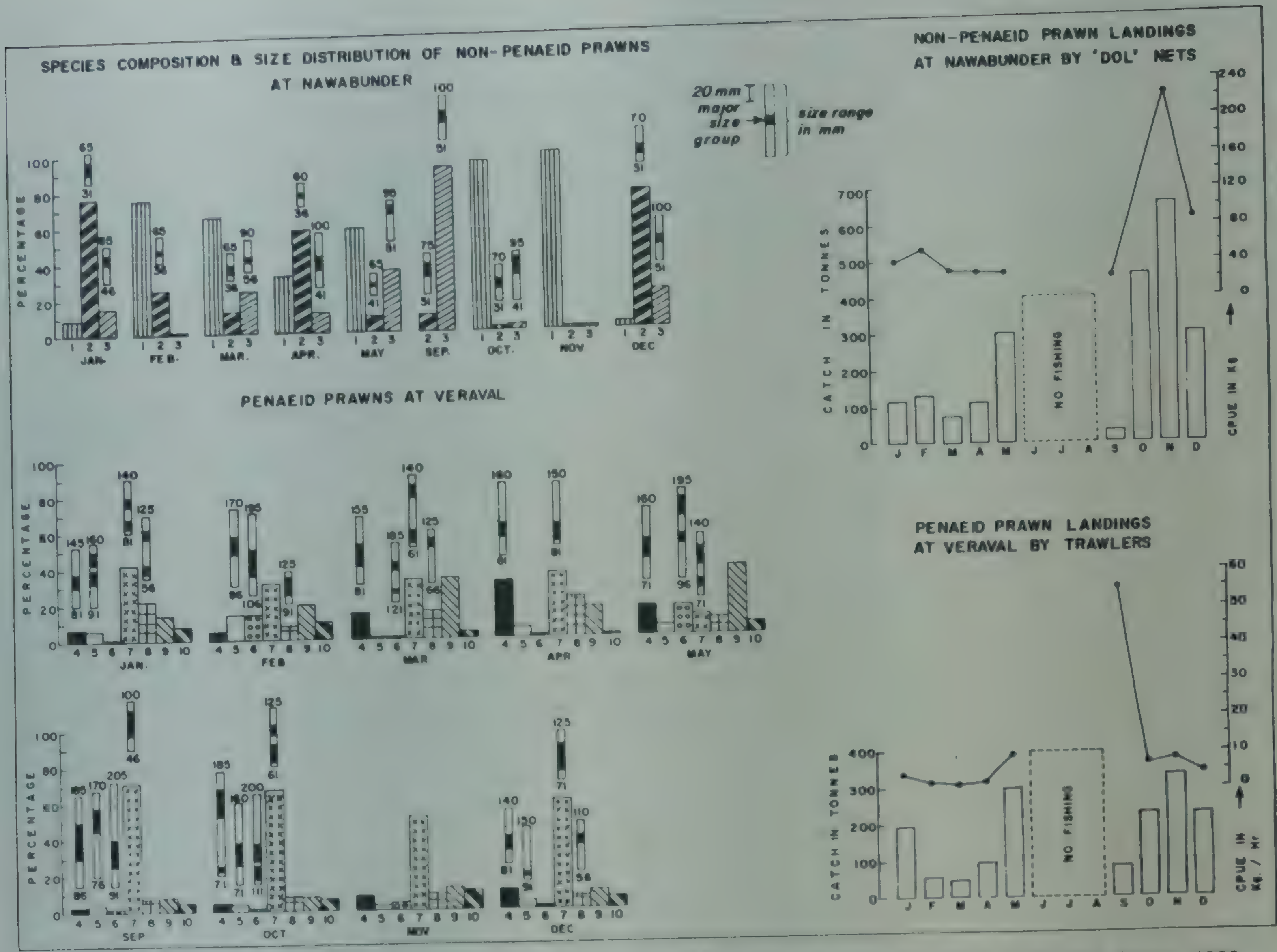

Fig. 2 Catch trend, species composition and size distribution of important species of prawns at Veraval during 1980. 1. *A. indicus*, 2. *N. tenuipes*, 3. *E. ensirostris*, 4. *M. kutchensis*, 5. *M. affinis*, 6. *M. monoceros*, 7. *P. stylifera*, 8. *P. hardwickii*, 9. *S. crassicornis*, 10. Others.

Biological aspects at selected centres

Veraval (Fig. 2)

With an estimated production of 1,590 t of penaeid prawns, shrimp trawling at this centre was active through out the non-monsoon period. The annual average catch/hour worked out to 4.39 kg, with maximum abundance in May and October-December period. In September, an unusually higher rate of yield was recorded for a few days. *Parapenaeopsis stylifera* (44.7%), *Solenocera crassicornis* (17.4%), *P. hardwickii* (10.4%), *Metapenaeus kutchensis* (10.0%), *M. monoceros* (5.1%), *M. affinis* (4.6%) and *Penaeus penicillatus* (2.6%) were the major species that contributed to the fishery. *S. crassicornis* was landed in enormous quantities during May and this was mainly responsible for the higher catch rates recorded in that month. The major size groups in the catches were 66–120 mm for *P. stylifera*, 61–70 mm and 91–120 mm for *P. hardwickii*, 141–195 mm for *P. penicillatus* and 91–135 mm for *M. kutchensis*. The mean sizes of *M. monoceros* and *M. affinis* ranged from 129.7 mm to 164.5 mm and 105.5 mm to 136.3 mm respectively. For most of the species peak spawning activities were noticed during January-May (Fig. 10).

The non-penaeid prawn fishery, as observed at Nawabunder, was also active throughout the non-monsoon period. An estimated quantity of 1,971 t of these prawns caught by 'Dol' nets at an average CPUE of 77.55 kg was composed of *Acetes indicus* (67.2%), *Nematopalaemon tenuipes* (23.1%) and *Exhippolysmata ensirostris* (9.7%). Peak landings were recorded during October-December.

Bombay (Fig. 3)

At New Ferry Wharf (previously Kasara Bunder) the trawler landings of penaeid prawns amounted to 6,431 t at an average catch rate of 319.5 kg/unit as against 358.8 kg of the previous year. The monthly production exceeded 1,000 t during September-December with a maximum of 1,400 t in November when the catch rate worked out to 609.2 kg. *P. stylifera* (51.2%) and *M. affinis* (21.6%) accounted for the bulk of the landings. *S.*

crassicornis (15.3%), which ranked third in abundance, dominated in the fishery from March to July. *M. monoceros* (5.6%), *P. hardwickii* (2.8%) and *M. brevicornis* (1.0%) were the other components in the catches. The major size groups of important species were 71–115 mm for *P. stylifera*, 111–145 mm for *M. affinis* and 61–110 mm for *S. crassicornis*. Peak spawning activities for the former two species were observed during January and November–December.

The 'Dol' net fishery, which accounts for the major portion of non-penaeid prawn landings of the region, was active throughout the year at Sassoon Dock and only during the non-monsoon period at Versova. An estimated quantity of 4,645 t of non-penaeid prawns landed at these two centres was considerably less than the production of the previous year (5,894 t). While the annual average CPUE did not show any change over that of the previous year at Versova, the same for Sassoon Dock registered a sharp decline from 135.4 kg to 69.3 kg this year. *Acetes indicus* contributed 73.4% at Sassoon Dock and 63.7% at Versova, followed by *Nematopalaemon tenuipes* and *Exhippolysmata ensirostris* in the order of their abundance. Peak breeding activities were noticed during July for *N. tenuipes* and August & May for *E. ensirostris*.

Karwar (Fig. 4)

With an estimated catch of 562.4 t the prawn fishery at Karwar indicated an improvement over the fishery of previous year in which the total catch was 495.3 t. The fishery was sustained mainly by trawlers, contributing nearly 98.6% of the total prawn catch and was continuous till May when the peak landing of 192.6 t and catch per hour of 36.7 kg was recorded.

P. stylifera, in sizes ranging between 51–130 mm in females and 71–115 mm in males was dominating in the catch in percentage of 46.2 contrasting the status of the fishery for the previous year, when *M. dobsoni*

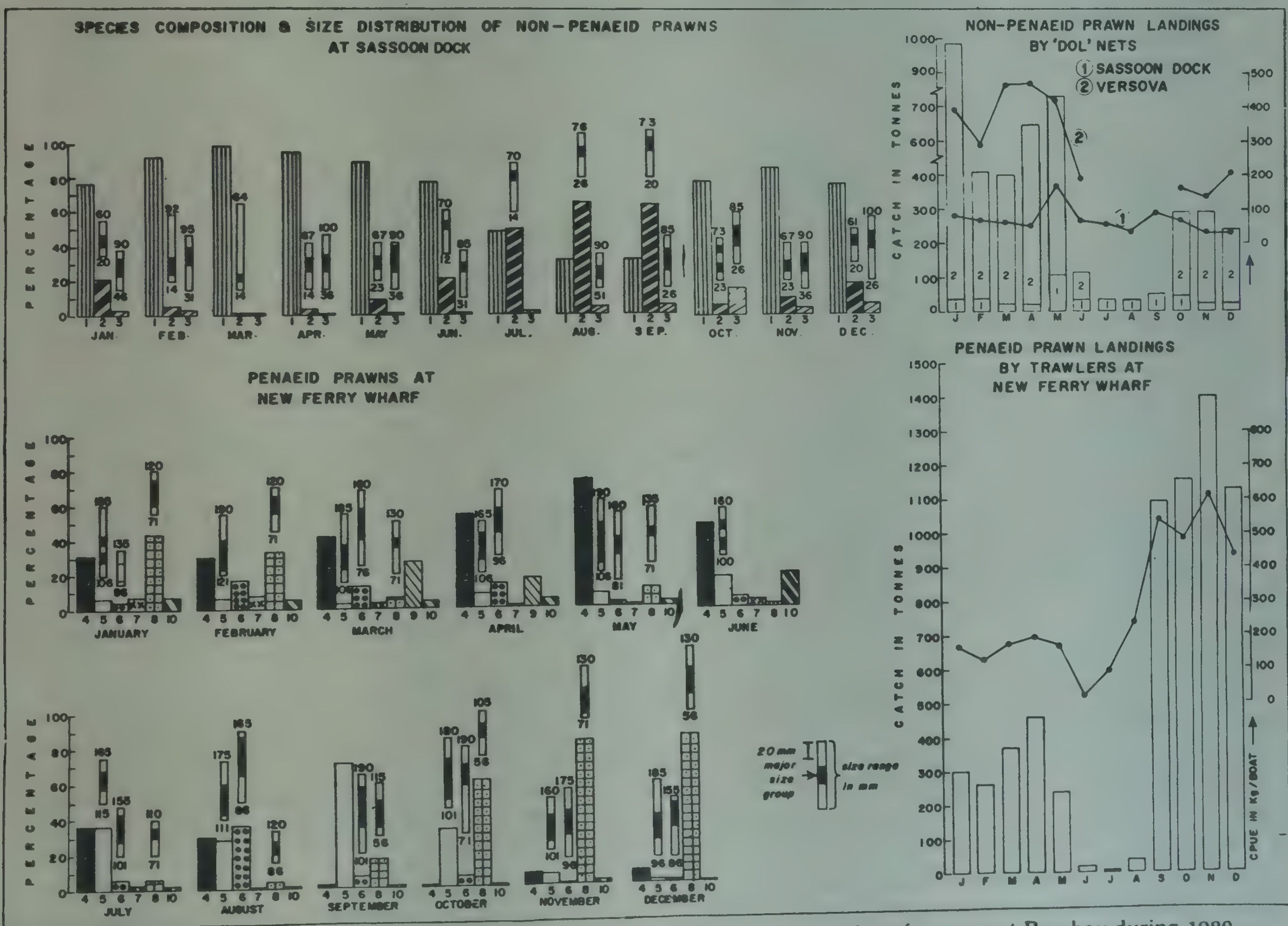

Fig. 3. Catch trend, species composition and size distribution of important species of prawns at Bombay during 1980. 1. *A. indicus*, 2. *N. tenuipes*, 3. *E. ensirostris*, 4. *S. crassicornis*, 5. *M. affinis*, 6. *M. monoceros*, 7. *M. brevicornis*, 8. *P. stylifera*, 9. *P. hardwickii*, 10. Other penaeids.

constituted the bulk of the catch by a percentage of nearly 36.0. In case of *P. stylifera*, the principal modes were at 51-55 mm, 71-75 mm and 86-90 mm in females and 71-75 mm and 86-90 mm for males. *M. dobsoni*, *M. monoceros* and *M. affinis* were the next important species in order of abundance in percentages of 25.4, 20.4 and 6.4 respectively.

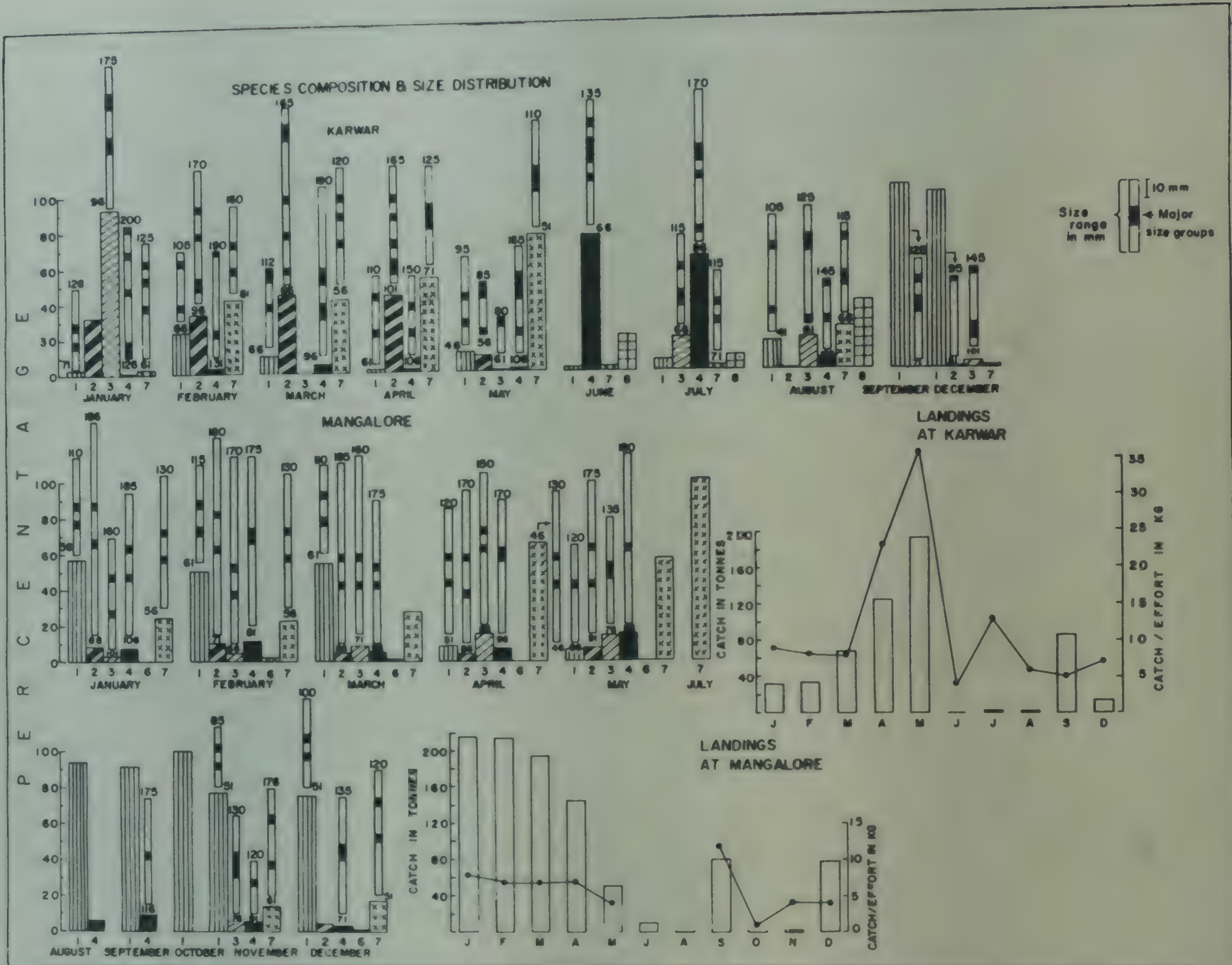

Fig. 4. Catch trend, species composition and size distribution of important species of prawns at Karwar and Mangalore during 1980.
1. *M. dobsoni*, 2. *M. monoceros*, 3. *M. affinis*, 4. *P. indicus*, 6. *P. monodon*, 7. *P. stylifera*.

The monsoon prawn fishery contributed mainly by the shore-seine, 'Yendi', accounted for a total catch of 5.8 t, of which *P. indicus* alone constituted nearly 44.0 percent.

Mangalore (Fig. 4)

The trawl fishery declined marginally during the year with an estimated annual landing of 979.7 t and catch per hour of 6.9 kg against the total catch of 1297.4 t and CPUE of 7.5 kg of the previous year. The maximum yield of 216.6 t was recorded during January having catch rate at 8.1 kg per hour. The CPUE was at the highest rate of 12.6 kg during September. The post monsoon fishery declined to such an extent during October and November when total yield came to only 0.2 t and 2.2 t respectively.

M. dobsoni constituted the dominating species in the catch forming nearly 49.4 percent. *P. stylifera* was the next species in order of abundance, constituting 30.0% of the total catch. *P. indicus* contributed to the fishery in a lesser percentage of 7.8 and *M. affinis* and *M. monoceros* in 6.1% each. In *M. dobsoni* the sizes were ranging between 51–120 mm, with modes in 71–75 mm and 96–100 mm groups for males and females respectively.

Calicut (Fig. 5)

As in the previous year the prawn fishery by trawls continued in the same magnitude for the first half of the year with a revival for short period of December and long break of about five months from July to November. The estimated total catch was recorded at 355.0 t and the catch per hour as 6.8 kg as against the total catch of 338.0 t of the previous year. When April recorded the maximum catch of 111.5 t, the highest rate of catch per hour of 43.3 kg was noted in June. The monsoon prawn fishery by indigenous gears yielded the maximum catch in July with an estimated total catch of 13.6 t and this mainly consisted of *M. dobsoni* (96.0 percent).

P. stylifera dominated in the trawl catch (56.3 percent), with size ranges of 46–130 mm. *M. dobsoni*, in

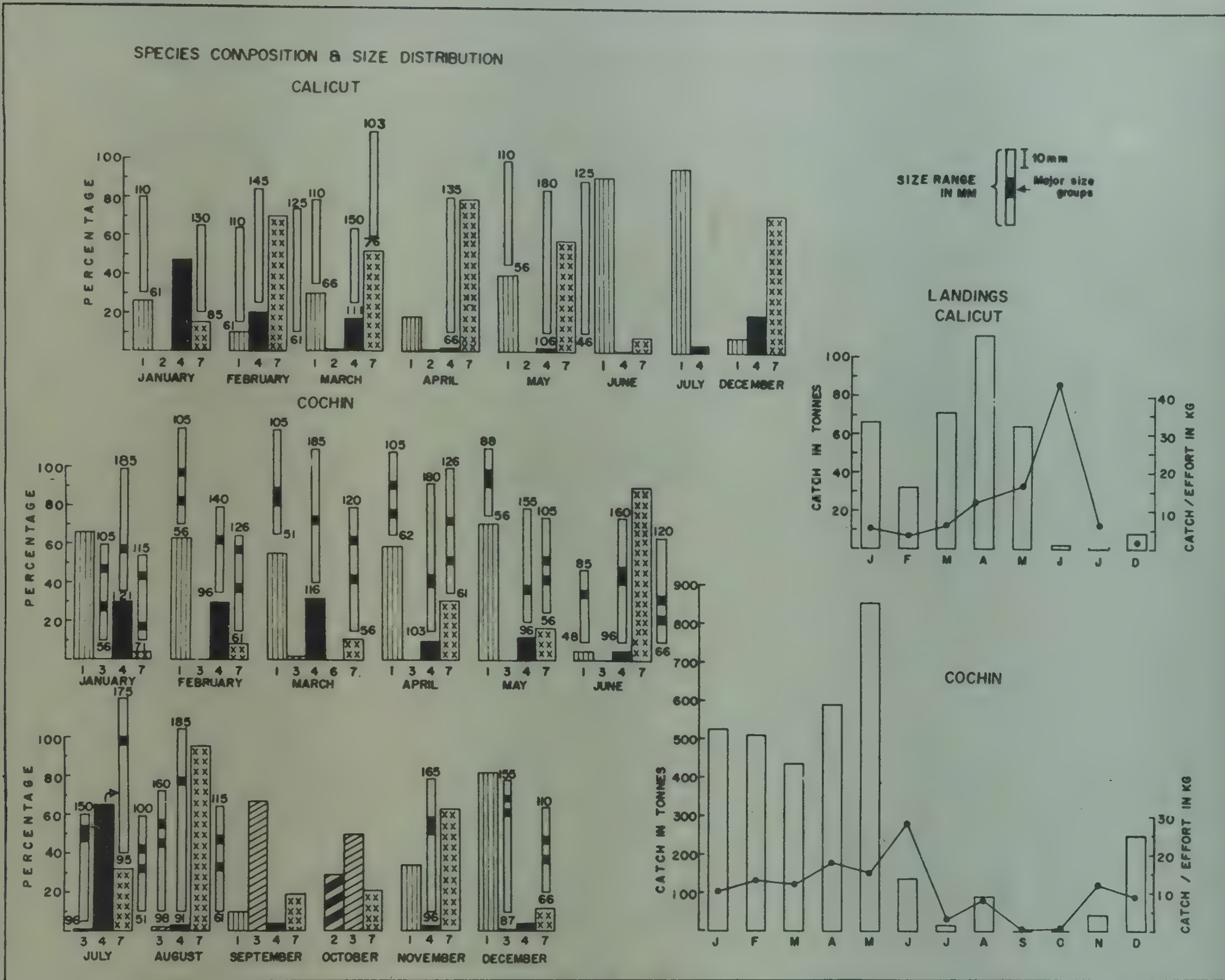

Fig. 5. Catch trend, species composition and size distribution of important species of prawns at Calicut and Cochin during 1980. 1. *M. dobsoni*, 2. *M. monoceros*, 3. *M. affinis*, 4. *P. indicus*, 6. *P. semisulcatus*, 7. *P. stylifera*.

length range of 56–110 mm was the second dominant species in the catch in percentage of 25.8. *P. indicus* were present in the catch in a lesser percentage of 15.0 in which sizes ranged from 66 to 180 mm.

Cochin (Fig. 5)

The annual estimated prawn catch at Cochin amounted to 3465.7 t with a CPUE of 12.9 kg per fishing hour as compared to the total landings of 3369.8 t and catch rate of 12.6 kg in previous year. May recorded the maximum catch of 855.6 t of which *M. dobsoni* alone constituted nearly 71.0 percent. During the monsoon prawn fishery, the peak landing of 137.2 t has been recorded during June with the highest catch rate of 28.0 kg for the year. The post-monsoon prawn fishery suffered a setback to such an extent that the total yield came down to even 0.3 t during October and reviving to a fairly good status with a total yield of 249.6 t in December.

M. dobsoni in size range of 46–105 mm with principal modes at 71–75 mm and 81–85 mm for males and females respectively was the dominating species for most of the period. They were dominating in percentages of 66.3, 58.5, 70.9 and 82.4 during January, April, May and December respectively. However, during monsoon *P. stylifera* constituted the bulk of the catch in percentages of 89.8 in June and 95.0 in August. The size ranges were 51–120 mm with modes at 81–85 mm and 96–100 mm for males and females respectively of the same species. *P. indicus* was occurring in fairly good percentages of 29.6, 28.6 and 32.0 during January, February and March respectively. In *P. indicus* length frequencies varied between 91–185 mm with modes at 131–135 mm for males and 151–155 mm for females.

Neendakara (Fig. 6)

The total prawn landings at Neendakara (Sakthikulangara) was estimated at 36,557.9 t with an annual catch rate of 43.1 kg as against the estimated total catch of 14,582.0 t and CPUE of 20.1 kg of the previous year. As

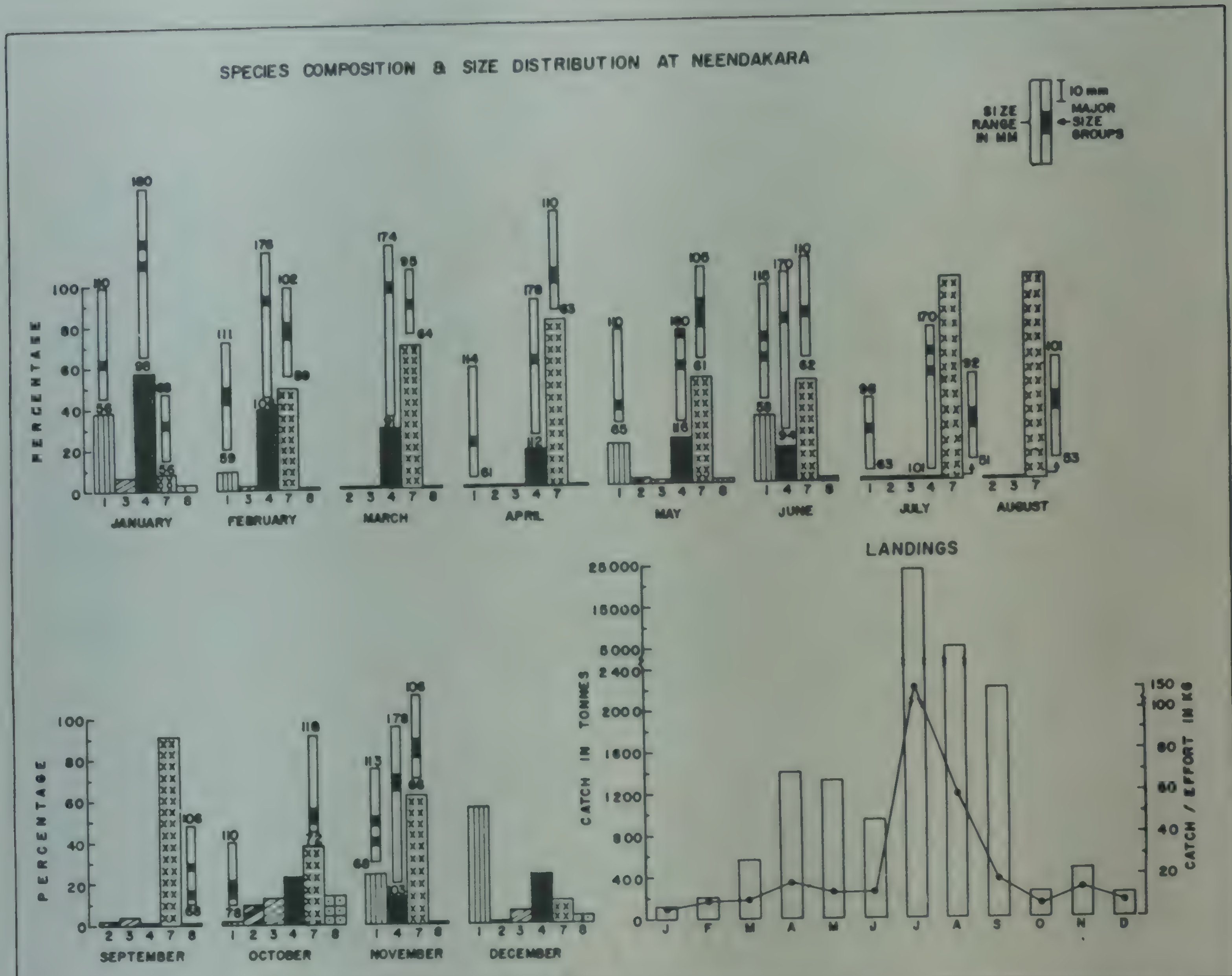

Fig. 6. Catch trend, species composition and size distribution of important species of prawns at Neendakara during 1980. 1. *M. dobsoni*, 2. *M. monoceros*, 3. *M. affinis*, 4. *P. indicus*, 7. *P. stylifera*, 8. Others.

in the previous year the fishery was at its peak during monsoon, in the month of July, when the total yield was estimated at 23,900.8 t of which *P. stylifera* alone contributed to 23,228.8 t. The highest rate of catch of 151.24 kg also had been noted during the month of July. The lowest catch rate of 5.7 kg and 5.3 kg were noted during October and January respectively.

P. stylifera occurring in size ranges of 51–118 mm with common modes at 71–75 mm for both the sexes was dominating in the catch in a percentage of 91.0. *P. indicus* and *M. dobsoni* were the next important species in percentages of 3.3 and 3.0 respectively. *P. indicus* occurred in size ranges of 94–180 mm with dominant size groups in 151–155 mm for both the sexes. In the case of *M. dobsoni*, 56–115 mm was the range in sizes and modes were at 81–85 mm for males and 86–90 mm for females.

Tuticorin

The prawn fishery was better during the period under report than that of the previous year. The catch from January to October was 1014 t as against 404 t of the previous year. This was due to the landings of mechanised boats operated off Manapad at the Tuticorin Fishing Harbour. The average catch per hour was nearly double (3.23 kg/hr) than that of the previous year, the maximum being in July (5.43 kg/hr) during which period maximum number of boats also operated. The lowest catch per hour was in February.

The constituent species in the fishery were *P. indicus* (42.68%), *P. semisulcatus* (39.07%) and *M. dobsoni* (8.15%). Peak landings of *P. indicus* was in July and that of *P. semisulcatus* in August.

The common sizes encountered in the fishery in the case of *P. indicus* was 96–185 mm in males and 110–230 mm in females. The dominant size in males was 126–170 mm while it was 121-200 mm in females. In *P. semisulcatus* the size ranges in males and females were 81–180 mm and 81–220 mm, respectively. The model sizes were 111–150 mm in males and 121–191 mm in females.

During the first quarter, immature prawns dominated the catches denoting the recruitment period of both the species.

The majority of females of *P. indicus* were mature during January, September and October, indicating peak spawning activities. In *P. semisulcatus* more than 50% of the females were mature throughout the year, with peak spawning activity in August to October.

Mandapam

The prawn landing at Mandapam was less (25.02 t) during the first two months of the year than that of the corresponding period of previous year (34.08 t). The mechanized boats operated in the night. About 62% of the prawn landed was *P. semisulcatus*, the rest being *M. affinis*. *P. merguiensis* appeared sporadically in the catches. During the third quarter of the year fishing operations were done only in Palk Bay, although in the last quarter about 50% of the boats operated in the Gulf of Mannar also. The estimated landings during the second half was 176.7 t with catch per unit of 12.86 kg. The percentage of *P. semisulcatus* in the catches varied from 90 in the third quarter to 55 in the last quarter.

During the first quarter the females of *P. semisulcatus* exhibited a size range of 91–175 mm with modes at larger sizes of 151 mm to 170 mm. In males the size variation was from 91–151 mm, the dominant size being 121–151 mm. The larger sizes in the last quarter were 106–181. The size range in *M. affinis* was 106–140 mm in the last quarter.

Mature females of *P. semisulcatus* dominated the catches in the first and last quarters. But, the females of *M. affinis* were mostly immature.

Madras (Fig. 7)

The prawn catch was less (183.02 t) during the year than that of the previous year (283.34 t). The most

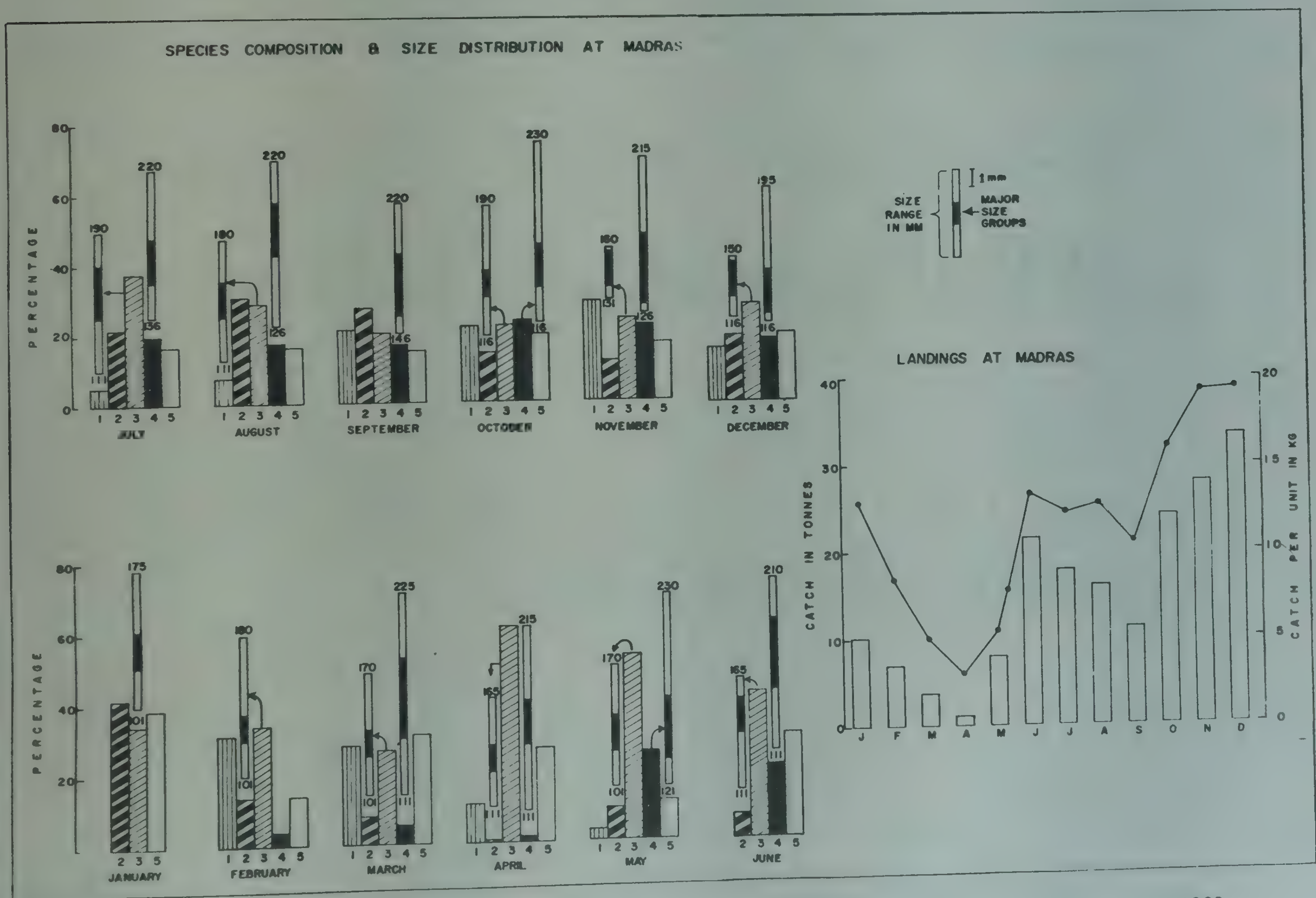

Fig. 7. Catch trend species composition and size distribution of important species of prawns at Madras during 1980.
1. *M. dobsoni*, 2. *M. monoceros*, 3. *P. indicus*, 4. *P. semisulcatus*, 5. *P. monodon*.

important constituent of the fishery was *P. indicus* (30%) followed by *P. monodon*, *P. semisulcatus*, *M. dobsoni* and *M. monoceros* in the order of abundance. The effort expended during 1980 was more (14,583 units) than that of the previous year (11,815 units). Thus the catch per unit was less (12.55 kg) than that of 1979 (23.98 kg).

In *P. indicus* the size range was from 101 mm to 190 mm, the modes being 121 mm to 175 mm. The total length varied in *P. semisulcatus* between 111 mm and 230 mm, with modes at 131 mm to 200 mm. In *P. monodon* the smallest sizes encountered in the catches were 106 mm while the largest were 270 mm. The size variation in *M. monoceros* was from 96 mm to 191 mm, the modes being 121 mm to 161 mm. The percentage of mature females in *P. indicus* varied from 30 in August to 100 in April and November. In *P. monodon* females ranging from 50 to 100% were mature. In *P. semisulcatus* also the mature females were 50 to 100%. In *M. monoceros* it was 66 to 93% during the various months of the year.

Kakinada (Fig. 8)

The prawn landings during the year was better during the present year than that of the previous year. The total landings amounted to 2,579.9 t this year as against 2,396.1 t of the previous year. This was mainly due to the increase in the catch during September to December. The total landings of penaeid prawns amounted to 1,972.2 t with an annual catch per unit of 48.9 kg. The maximum catch per unit in penaeid prawns was in July (104.7 kg) while it was least during April (18.4 kg). The maximum effort was put in February (3,759 units/39,097 hr) with catch per unit of 45.2 kg.

The species which contributed to the prawn fishery were *M. monoceros*, *M. dobsoni*, *P. stylifera*, *M. lysianassa*, *M. brevicornis*, *P. indicus*, *P. monodon* & *M. affinis* in the order of abundance. The catch of all these penaeid species was more during this year than that of the previous year except in *M. lysianassa*.

The size ranged from 56 to 110 mm in *M. dobsoni* with modal size of 76–90 mm. In *M. monoceros* the size variation was between 41 mm and 190 mm while the dominant groups were of the size 81 to 145 mm. The total length in *P. indicus* varied from 71 mm to 195 mm with dominant size of 116 to 155 mm.

Mature females of *M. monoceros* were abundant

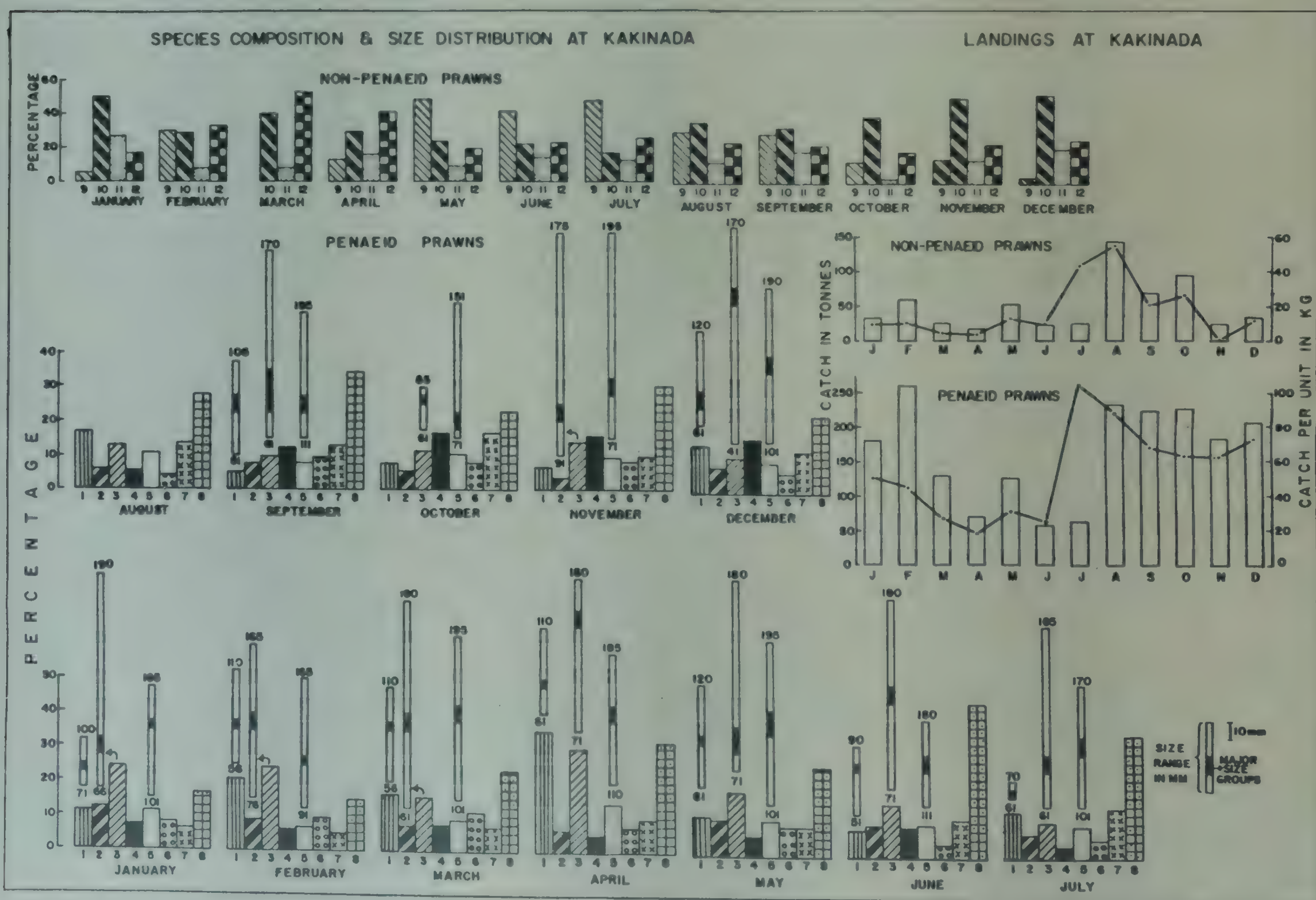

Fig. 8. Catch trend, species composition and size distribution of important species of prawns at Kakinada during 1980. 1. *M. dobsoni*, 2. *M. affinis*, 3. *M. monoceros*, 4. *M. brevicornis*, 5. *P. indicus*, 6. *P. monodon*, 7. *P. stylifera*, 8. Other penaeids, 9. *Acetes* spp. 10. *E. styliferus*, 11. *N. tenuipes*, 12. *E. ensirostris*.

during January to July. In *M. dobsoni* catches, this trend was observed during the first half of the year. Majority of female specimens were mature during February to October in *P. indicus* (Fig. 9). But, in *M. brevicornis* higher percentages of mature females were encountered during the later half of the year.

The total quantity of non-penaeid prawns caught during the year under report was 607.6 t as against 745.3 t of previous year. The catch per unit was 15.1 kg during this period while it was less (13.9 kg) during the previous year.

The major non-penaeid prawn species contributing to the fishery were *Exopalaemon styliferus* (220.7 t); *Acetes* spp. (148.5 t); *Exhippolysmata ensirostris* (147.0 t) and *Nematopalaemon tenuipes* (89.6 t).

Waltair

The fishery was good during the first quarter during which period 186.49 t of prawns were landed. The catch per hour was 4.5 kg in February which was less than that of the corresponding period of previous year. But in March the CPUE decreased considerably to 1.1 kg per hr. This reduction in the catch was noticed in the previous year also. *P. indicus* was not caught in February and March. The most important species of the fishery was *M. monoceros* forming 70.8% of the total prawn landings. This was followed by *P. indicus* (17.8%) and *P. monodon* (4.4%).

The larger size range in *M. monoceros* was 160–180 mm. Ripe females of this species was occurring throughout the period.

Puri (Fig. 9)

The prawn fishery was better during the current year than that of the previous year. The total prawn landings amounted to 56.18 t in this year while it was only 52.07 t in the previous year. *P. merguiensis* was the most important constituent of the fishery, forming 57.81% of the total prawn landings. The next dominant species are *P. indicus* (30.77%) followed by *M. affinis* (12.1%). *P. merguiensis* was not occurring in the catches during January to May. *P. monodon* was caught in small quantities in January only.

The size range in *P. merguiensis* was from 126 to 210

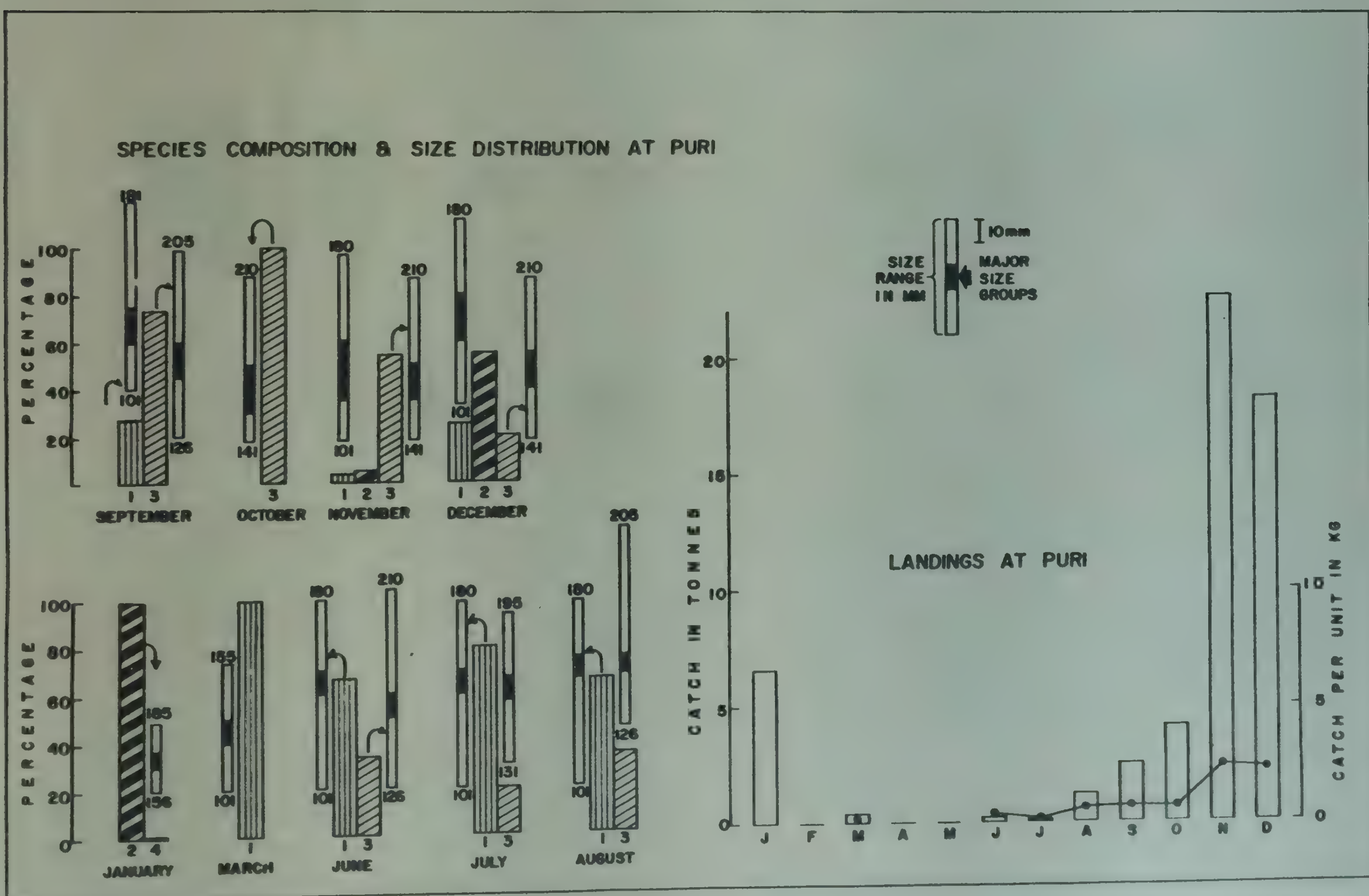

Fig. 9. Catch trend, species composition and size distribution of important species of prawns at Puri during 1980.

1. *M. affinis*, 2. *P. indicus*, 3. *P. merguiensis*, 4. *P. monodon*.

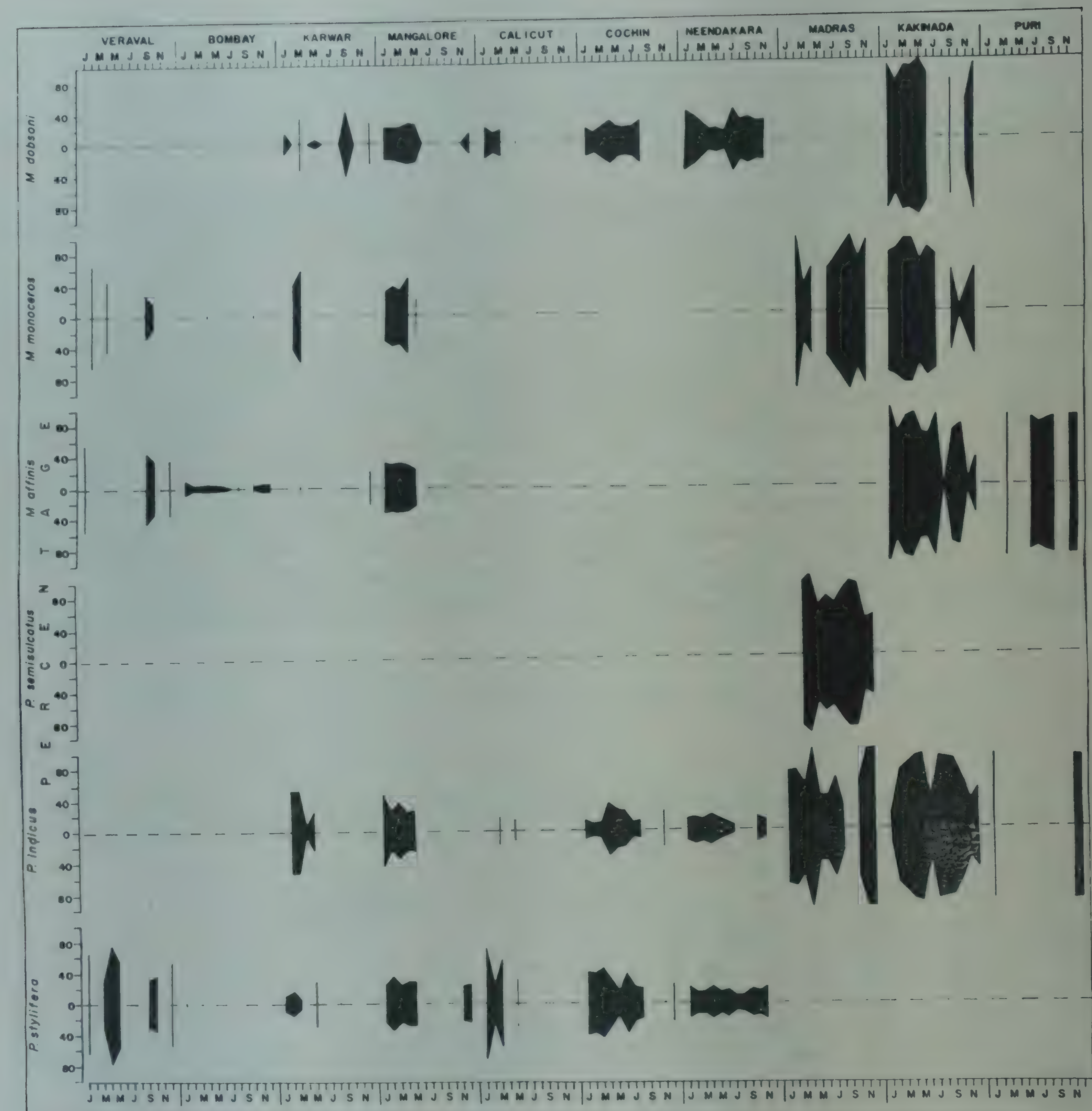

Fig. 10. Distribution of the spawning population of important species at selected centres during 1980.

mm with modal size of 151-161 mm. In *P. indicus* the length varied from 141 to 210 mm with 161-171 mm size forming the dominant groups. *M. affinis* ranged in size from 101 to 180 mm, the modal sizes being 126-160 mm.

The percentage of mature females in the catches varied from 75.0 to 91 in *P. merguiensis* during the second half of the year. In *P. indicus* the range was 90-92% during this period and 78 to 90% in *M. affinis*.

A POTENTIAL NEW RESOURCE OF PRAWNS FROM NEENDAKARA AREA IN KERALA COAST*

In recent years Neendakara - Sakthikulangara area in Kerala has emerged as a prominent prawn fishery centre of the country. In view of the importance of this trawl fishery the Central Marine Fisheries Research Institute has been monitoring the resource with reference to species composition, catch potential and biological parameters of the fishery for the past several years. The main fishing season in this area is the monsoon months June - August when an average of about 35,000 tonnes of prawns are landed, most of which (76%) are contributed by the species *Parapenaeopsis stylifera* locally known as 'Karikadi'. This is a species growing to a small size upto about 130 mm. The bigger species *Penaeus indicus* ('Naran') contributes to a lesser percentage. Species like *P. monodon* ('Ocean Black - Tiger') and *P. semisulcatus* ('Ocean Black - Flower') are also found in the catches occasionally.

It is reported that night trawling in the sea off Sakthikulangara and other neighbouring centres is forebidden by Government order. However, every year some trawlers owned by the local people operate occasionally during night in the usual shrimp trawling grounds (upto about 25 m depth) for 2-3 months after the monsoon fishery is over. In 1981 it was noticed that soon after the main season for 'Karikadi' was over in August - September about 80-100 trawlers started going for night fishing from October onwards. About 50% of these boats operating in slightly deeper areas outside the conventional trawling grounds landed on an average 56 kg of prawns each. The catch details on certain observation days are given in Table 1, the total catch of prawns for one night being estimated at an average of 2,520 kg. The most striking feature of these catches is that they are constituted by a group of species entirely different from those commonly occurring in the monsoon fishery of this area. The species *Panaeus canaliculatus* (Fig. 1), termed by the industry as 'Ocean Black - Zebra', ranging from 150 to 200 mm in total length, contributed to 35% (19.6 kg/boat) of these catches. The remaining portion mostly consists of smaller unconventional species such as *Trachypenaeus curvirostris*, *T. sedili*, *Metapenaeopsis mogiensis* and *Solenocera choprai* (Fig. 2). Out of the estimated catch per night of 2,520 kg, *P. canaliculatus* accounted for 882 kg. These prawns were particularly more during the nights of bright moon light as told by the fishermen.

P. canaliculatus similar to the tiger prawn is especially attractive to the industry in view of the large size, numbering 22/kg ('head on') for females and 29/kg for males. It fetches about Rs 75 to 100/- per kilogram to the fishermen. Analysis of samples showed that female prawns, of which 83% had ovaries in the late-maturing or matured condition, dominated in the catch and the sex ratio was 56 : 44.

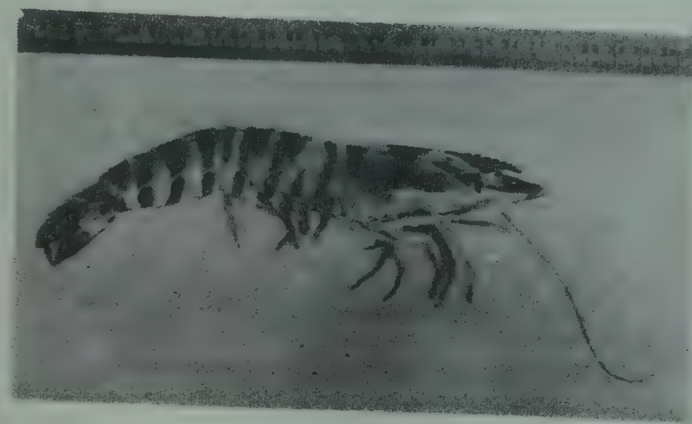

Fig. 1. ***Penaeus canaliculatus***

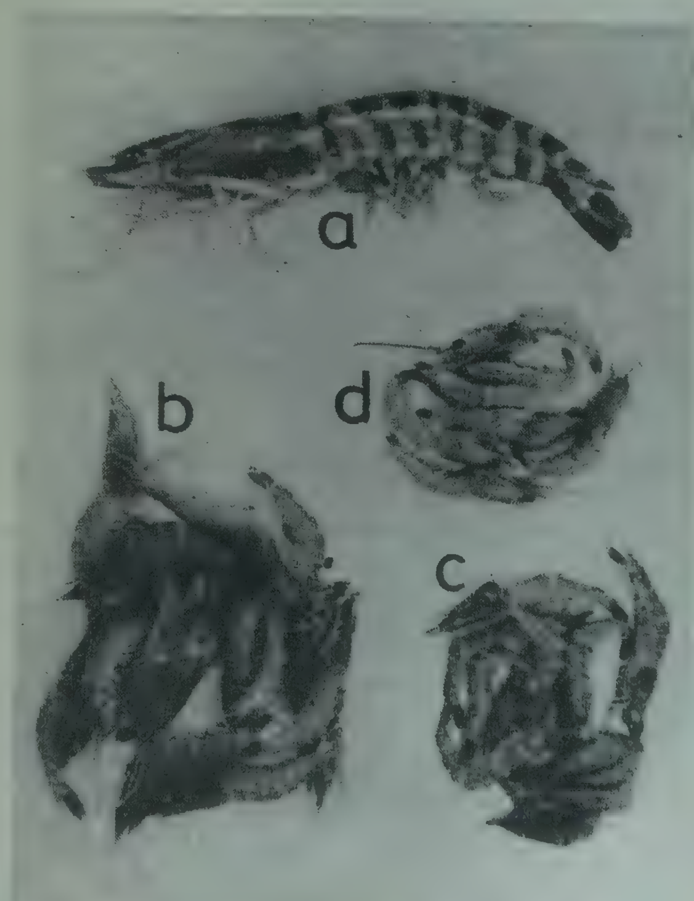

Fig. 2. A sorted out sample of prawn catch. a - *Penaeus canaliculatus*, b - *Trachypenaeus curvirostris* and *T. sedili*, c - *Metapenaeopsis mogiensis*, d - *Solenocera choprai*

*Prepared by C. Suseelan, M. M. Thomas, N. S. Kurup and K. N. Gopalakrishnan with the guidance of M. J. George.

Although juveniles of *P. canaliculatus* have been found to occur in small numbers in the Cochin backwaters and Ashtamudi Lake in recent years, it has never been recorded to form such sizable portion of the fishery anywhere in the coastal waters of India. It would appear as though the new resource has been recognised as a result of the change in the time of fishing.

Unfortunately this fishery did not last long since there was strong protest from the indigenous fishermen who operate gill-nets and hooks and lines in the offshore waters during night as they complained that their gears were being damaged by these operations and also from the fishermen who operate trawl nets during day time in the usual shrimp trawling grounds fearing disturbance to the fishing ground and consequent reduction of their catch in the morning. Thus by about the middle of November, 1981 the night trawling was stopped by the intervention of the Government.

In order to confirm whether similar concentrations of these unconventional species occur in the neighbouring areas of the same depths, a few experimental shrimp trawling was conducted off Cochin during January and February, 1982. Trawl hauls were taken at 10,20,30 and 40 m depth during night and day time. The results indicated that while smaller species occurring in the conventional fishery of the area were present in abundance in the hauls taken at 10 and 20 m depth they were very scarce in the catches from 30 and 40 m depth region. At the same time the hauls from greater depths yielded larger species like *P. semisulcatus*, *P. monodon* and *Metapenaeus monoceros* in relatively more numbers during day time while in the night the catches from the same depth region were dominated by the unconventional species like *P. canaliculatus* and *Trachypenaeus* spp, noticed in the night fishery of Sakthikulangara area mentioned earlier. This would indicate that the resource of the above species are probably available all along this coast in slightly deeper regions in varying concentrations for exploitation during night, depending on the behaviour of the species. However, further detailed experimental fishing and monitoring are necessary to establish the magnitude and distribution pattern of these resources for which the Institute has already initiated action.

The points for consideration in the exploitation of this valuable potential resource are: 1) For quite some time now, ever since juveniles of *P. canaliculatus* started appearing in the fishery during certain seasons; first in the Cochin backwaters and later in the Ashtamudi Lake, the scientists of CMFRI were on the look out for the adult population giving rise to these younger generations. The location of these concentrations of large size prawns has come as an answer to their search. As long as these juvenile prawns of the species are found in the inside waters it is an indirect indication that the adult population would be occurring somewhere outside.

2) The peculiar behaviour of these prawns is such that they are available in the fishery during nights only and not seen anywhere in the nearby areas in the conventional day time fishery except for rare specimens. So, if at all this resource is to be made use of, night fishing has to be resorted to.

3) At the same time night fishing is resisted by the indigenous fishermen for reasons mentioned earlier. A compromise has to be worked out for exploitation of the new resource taking into consideration all the economic factors and the conflicts involved.

Table 1: *Details of night catch of prawns in shrimp trawlers operated at about 30–35 m depth off Neendakara*

Serial No. of units examined at random	Landings in kg					
	24.10.1981			*10.11.1981*		
	P. canaliculatus	Other species	Total prawns	*P. canaliculatus*	Other species	Total prawns
1	18	45	63	15	28	43
2	27	50	77	12	30	42
3	35	35	70	8	25	33
4	36	45	81	10	25	35
5	20	68	88	2	6	8
6	27	35	62	–	–	–
7	26	50	76	–	–	–

4) The specimens of *P. canaliculatus* caught in the night fishery reported are quite large and constitute adult population of the species. If this population is not exploited from the area at the right time the fishery will be only lost every year due to natural mortality.

5) The indications at the moment are that the occurrence of the resource here is seasonal, and that after the main Karikadi fishing season of the area. Whether it is strictly seasonal or available throughout the year or for an extended period in the year needs to be investigated.

We are deeply grateful to Dr. E. G. Silas, Director, CMFRI for constant encouragement in the persuit of this study.

BOOKS

Fishes of the Laccadive Archipelago. By S. Jones and M. Kumaran. Nature Conservation and Aquatic Sciences Service, Trivandrum, pp 760, 1980.

This is one of the most important ichthyological work from Indian Ocean region. The faunistic study is first of its kind from the Laccadive area in view of the fact that there is no reference to any fish from the Laccadives or the Lakshadweep, as known in Malayalam, in the *Fishes of India* by Francis Day or in the *Catalogue of the Fishes of the British Museum* by Albert Günther. Till recently our knowledge of the ichthyofauna of this area was limited to about three dozen species, mostly bathypelagic, from the collections made by R.I.M.S. Investigator towards the end of the last century.

The Lakshadweep group of islands are located off the south west coast of India and consists of 10 inhabited islands viz., Agathi, Ameni, Androth, Bitra, Chetlat, Kadamat, Kalpeni, Kavarathi, Kiltan and Minicoy and a dozen uninhabited islands, many of them adjacent to the main islands connected by submerged reefs and is separated from the Maldive Islands in the south by the eight degree channel. Exposed and surf ridden reefs and sand mounds of varying magnitude occur in between some islands. The greatest depth of the sea in between the islands may be anything upto 1500 meters. All the inhabited islands except Androth are protected by shallow lagoons and the outer reefs around the lagoons. The extensive coral reefs, lagoons and abysses around are the abode of an extremely rich and varied fish fauna due to the wide diversity of ecological niches created by the various constructive and destructive agencies in the environment.

This book deals with 603 species of fishes based on the critical examination and study of about 14,000 specimens collected for the purpose from the area. Among the species described, about 150 species were not known from the seas around India before the initiation of the work. The descriptive account of the fishes along with the diagrams and the simple keys have been prepared with the main objective of enabling the layman and the scientist to identify and study any fish occurring in the area. The descriptions are mostly based on study of actual specimens, the descriptions of only 38 species being taken from other publications.

The distribution of the species indicates that the fish fauna in general is typical of the fishes inhabiting the Indo-west Pacific. The oceanic and bathypelagic fishes occurring in the western Indian Ocean and Lakshadweep area are similar and predominated by equatorial species. The majority of species including the rare ones found in the Lakshadweep are dominant in the western Indian Ocean. But there are significant differences in the composition of the littoral fish fauna. From the pattern of distribution the authors suggest that the western Indian Ocean, Red Sea, West coast of India and Ceylon including Laccadive and Maldive Archipelagoes fall within the Western Indian Ocean ichthyofaunistic zoog eographic division.

This is a useful reference work and will be a valuable source of information for a long time to come in view of the scientific accuracy of the drawings, nomenclature and other details concerning the fishes of this area. It would also stimulate similar works from other parts of India. It will be a most welcome addition to libraries both inside and outside the country and most useful for students, researchers and naturalists.

Compiled and prepared by M. J. George, C. Suseelan, M. M. Thomas, N. S. Kurup, C. Nalini and G. Subbaraju. Published by Dr. M. J. George, Senior Scientist on behalf of the Director, Central Marine Fisheries Research Institute, Cochin-682 018 and printed at PAICO, Cochin-31

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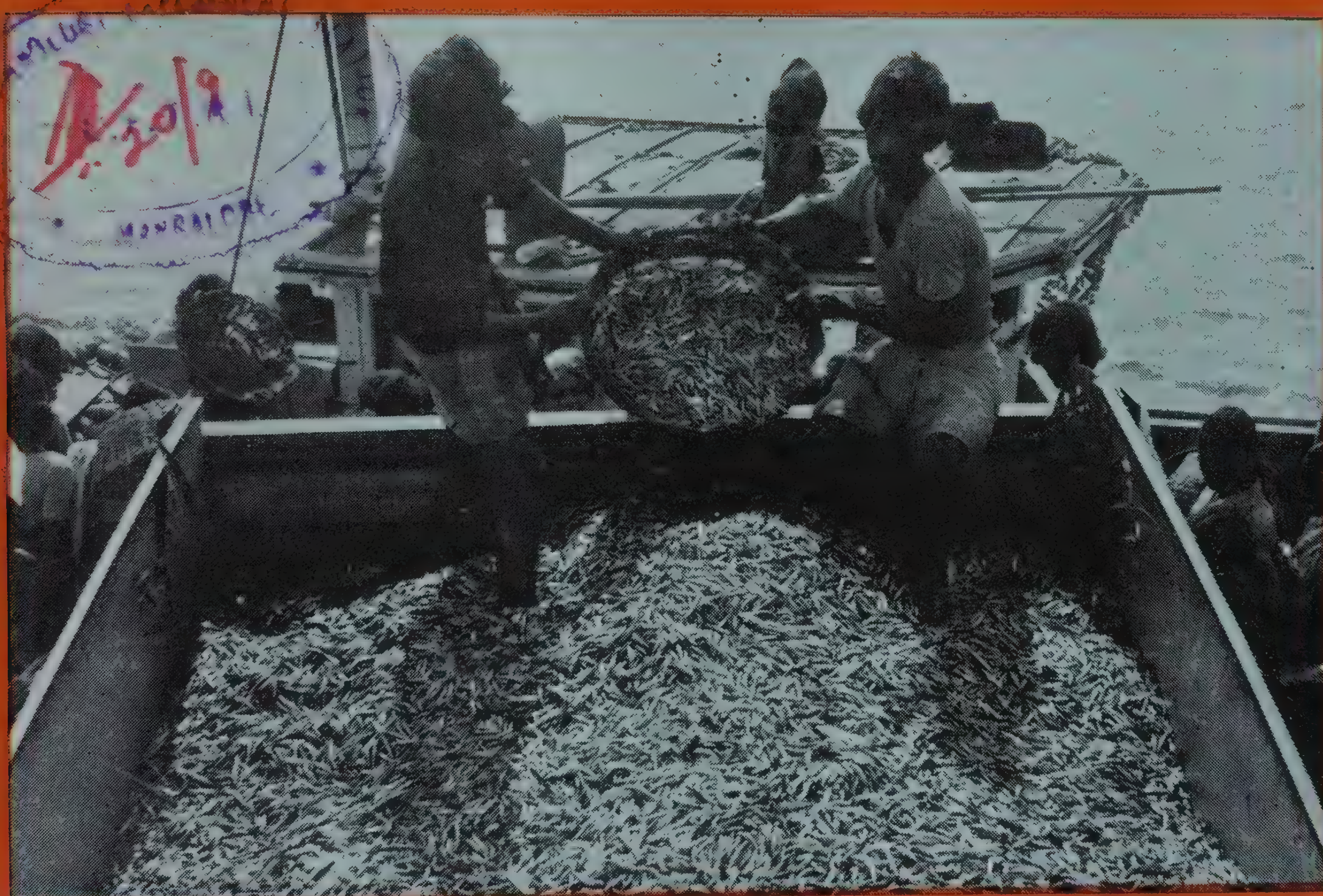

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Abbreviation – *Mar. Fish. Infor. Serv. T & E Ser., No.* 36 : 1982.

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Cover photo: Purse seine catches of whitebait being loaded into lorry for transportation from Mangalore.

THE EMERGING PURSE SEINE FISHERY FOR ANCHOVY (WHITEBAIT) RESOURCES OF THE WEST COAST OF INDIA*

Introduction

One of the most significant developments in the marine fisheries sector, in recent years is the large scale introduction of purse seine fleets along the coasts of Karnataka and Kerala, for the commercial exploitation of pelagic fish resources. This development may be considered as significant as the introduction of mechanized trawling in late fifties in Indian waters for the exploitation of shrimp resources.

Though purse seining was introduced about a decade ago by the state authorities in Goa and by the erstwhile Indo-Norwegian Project in Kerala for exploratory fishing, the recent development of big fleets of purse seiners, with the introduction of about 200 boats in Karnataka and 60 in Kerala in a matter of 2-3 years only has created considerable management problems. Some of these have been lucidly brought out by Silas *et al.* (*Mar. Fish. Infor. Serv. T & E Ser.* No. 24, 1980). One of the disquietening features of the purse seine fleets presently operating, however, is that they employ gear with a mesh size of about 12-13 mm, both for small as well as big pelagic species. As a result increased amounts of very young fish of important pelagic species like oil sardine, mackerel, horse mackerel and scad are being caught year after year. This, besides being a wasteful utilisation of the resources, will lead to decreased catches. Appropriate mesh regulation is, therefore, a rational approach in the exploitation of these fisheries.

It may also be stated further that the present infrastructure available for handling, processing and marketing of the fish landings has built-in capacity only to meet the requirements of the artisanal fishery, but inadequate to meet the demands of a far more efficient purse seine fishery that brings in tremendous amounts of pelagic fish catch. Consequently, there is considerable waste in utilization, fluctuations in price structure and a serious impact on the traditional (artisanal) fishery in a complex manner.

The purse seine fleets of Karnataka and Kerala, in addition to exploiting the resources of oil sardine, mackerel and horse mackerel of the areas, have since been able to fish increased quantities of whitebait (*Stolephorus*) resources during the months October-December, resulting in unprecedented landings especially off Karnataka coast in 1980 fishery season. An account of this emerging whitebait fishery is presented here based on the observations made during October-November 1980.

Purse seine fishery for whitebait

From the point of development of this new fishery, Mangalore in Karnataka and Cochin in Kerala occupy prominent places. From 73 tonnes landed by purse seines during 1978 at Mangalore, the annual whitebait catch rose to about 721 tonnes in 1979 and shot up to 4,588 tonnes in 1980. The fishery yielded an estimated catch of 2,240 tonnes in 1981. Although the whitebait landings at Cochin, compared to Mangalore, were of lower magnitude, the same trend in the increased production at this centre also was evident over the years. Thus, from a meagre catch of about 4 tonnes in 1979, the whitebait landings rose to 255 tonnes in 1980 and 319 tonnes in 1981 (Table 1). In these years especially in 1980 the bulk of the catches was landed during a short period of three months (October - December) at both the centres as evident from Table 2. It may be seen from the data that during the main fishery season, peak landings were obtained in October at Cochin and October November at Mangalore.

The unprecedented landings of 1980 season

The unprecedented landings of whitebait during October November 1980 at the purse seine landing centres at Cochin in Kerala and at Mangalore, Malpe and Gangoli in Karnataka were closely monitored. The centre-wise data on the catch and fishing effort during the above period are presented in Table 3. The peak landings were obtained in October at all the observation centres. It is to be mentioned, however, that the peak fishery started by 1st October off Cochin, and only by about 22nd October at most of the centres in Karnataka.

Table : 1. *Annual whitebait landings (in tonnes) by the purse seine fleet at Cochin and Mangalore Centres*

Year	Cochin	Mangalore	Total
1979	4.3	720.9	725.2
1980	255.3	4588.3	4843.6
1981	319.0	2239.7	2558.7
Total	578.6	7548.9	8127.5

*Prepared by K. V. Narayana Rao, G. Syda Rao, G. Luther and M. N. Kesavan Elayathu.

Table : 2. *Whitebait landings (in tonnes) by purse seine fleet during the period October – December*

Year	Mangalore				Cochin			
	Oct.	Nov.	Dec.	Total	Oct.	Nov.	Dec.	Total
1979	152.2	321.8	65.2	539.2	0.8	0.2	–	1.0
1980	2255.0	2071.0	133.0	4459.0	175.4	55.0	22.6	253.0
1981	98.6	950.2	322.1	1370.9	31.0	19.0	13.0	63.0
Total	2505.8	3343.0	520.3	6369.1	207.2	74.2	33.6	317.0

Table : 3. *Estimated total landings (in tonnes) of Whitebait by the purse seine at main centres in Kerala and Karnataka*

State	Centre	Period	No. of purse seine units	Whitebait	Other fish
Kerala	Cochin	Oct. 1980	53	175.4	3.8
		Nov. 1980	26	55.0	6.1
Karnataka	Mangalore	Oct. 1980	358	2255	166
		Nov. 1980	372	2071	33
	Malpe	Oct. 1980	423★	653	765
		Nov. 1980	218★	272	1098
	Gangoli	Oct. 1980	271★	193	1185

★This number includes the units employed both for Whitebait and other pelagic fishes.

During the peak whitebait season it was generally observed that the purse seine units exploiting this resource off Mangalore were able to get pure catches amounting to 2–10 tonnes, usually 5–6 tonnes, per haul (Fig. 1), while off Cochin usually 2–3 tonnes with very little amount of miscellaneous catch. These characteristics of the purse seine fishery are to be taken into consideration while estimating the catch and effective effort for the exploited resource both for the day and the season. It is also observed that at Mangalore, where the largest fleet of purse seiners is operated, the purse seine fishermen seem to exercise some sort of selective fishing in favour of those resources that fetch higher and more remunerative prices.

Fig. 1. Purse seiner with whitebait catch at Mangalore Fisheries Harbour.

Fishing grounds

During the peak season, purse seining for whitebait is carried out mostly in depth of 10–20 m at Mangalore and in 15–25 m at Cochin, within a distance of about 5–8 km from the shore during day time. While the purse seine fishery is confined to the limited area off Cochin in Kerala, it is more widespread in Karnataka, from Manjeswar in the south to Bindur in the north, extending over a stretch of 150 km.

Fishermen generally are able to identify the whitebait shoals from the presence of sea-gulls diving for fish, as well as from the appearance of moving shadowlike light-brown tinged patches on the sea surface. The number of hauls made during a day varied from 1 to 3, each haul taking about 1½ to 2 hours for an average-sized shoal of fish.

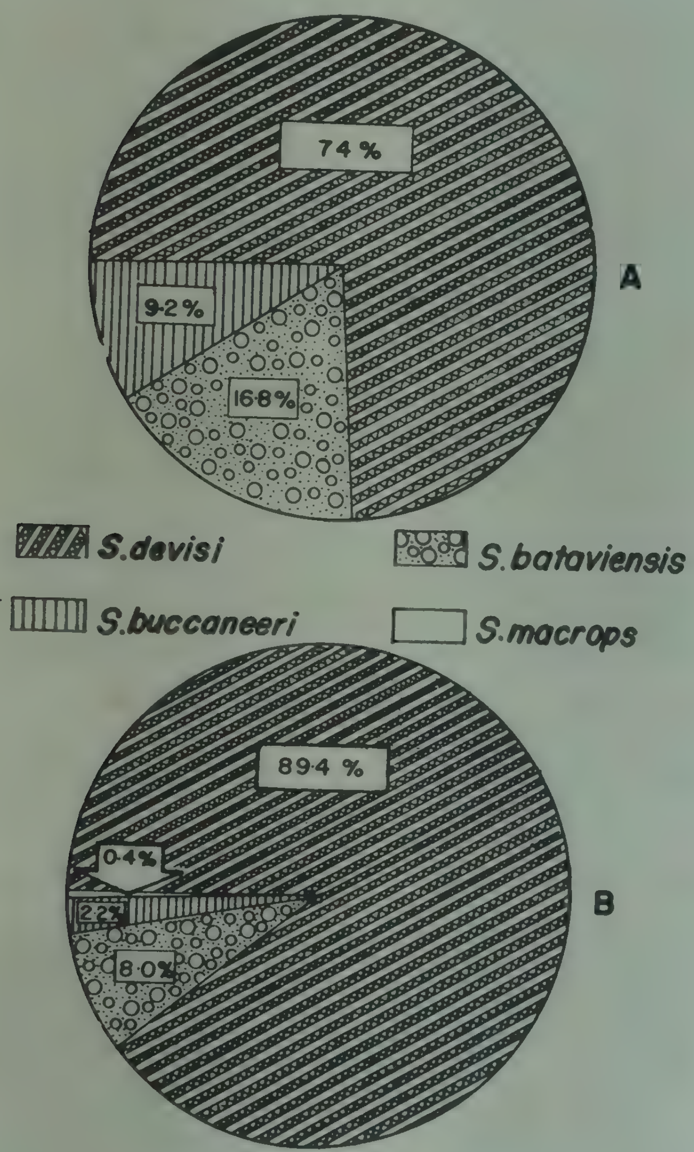


Fig. 2. Species composition (% wt.) of whitebait landings during October-November 1980. A. At Cochin, B. At Mangalore.

Species composition

The peak whitebait fishery during the period was mainly sustained by three species, viz., *Stolephorus devisi*, *S. bataviensis* and *S. buccaneeri*. Among these, *S. devisi* was the chief contributor both at Mangalore and Cochin, accounting for 89.4% and 74% respectively followed by *S. bataviensis* (8% and 16.8%) and *S. buccaneeri* (2.2% and 9.2%). Small quantities of *S. macrops* were also landed at Mangalore (Fig. 2).

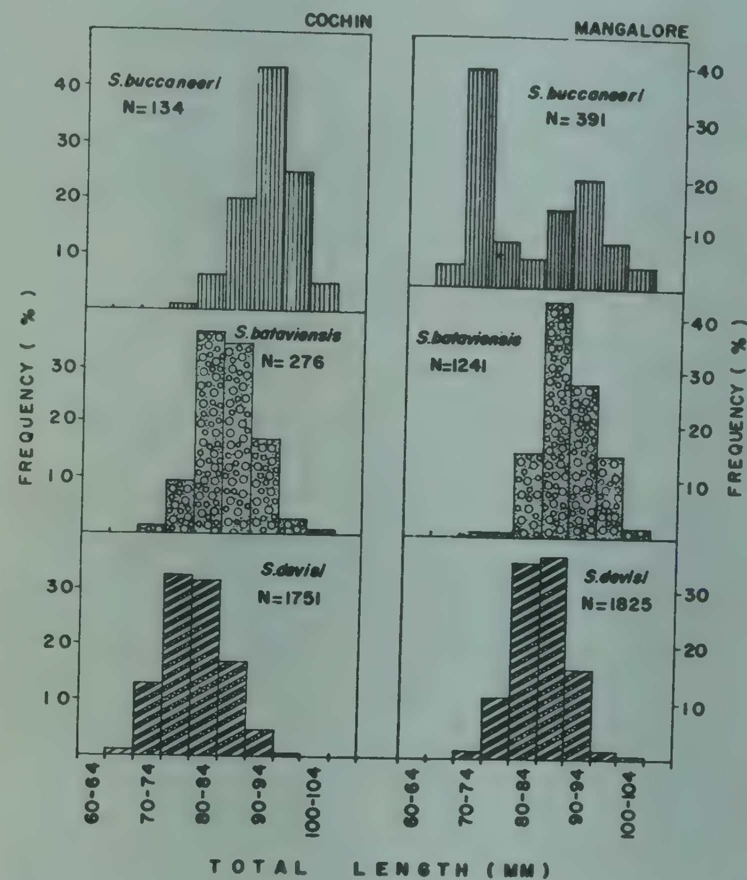


Fig. 3. Length distribution of the dominant species of whitebait at Cochin and Mangalore during October-November 1980.

Biological aspects

The length composition of the three dominant species at Cochin and Mangalore during the period Oct/Nov 1980 is given in Fig. 3. The dominant size of fish in respect of each species were: 75–84 mm at Cochin and 80-89 mm at Mangalore for *S. devisi*; 80-89 mm at Cochin and 85–94 mm at Mangalore for *S. bataviensis*; and 90–99 mm at Cochin and 70–74 mm as well as 85–94 mm at Mangalore for *S. buccaneeri*.

It is evident from the above size distributions that except in the case of *S. buccaneeri*, larger fish appear to be more abundant in the fishery at Mangalore than at Cochin. From the information available on the growth, maturity cycle, mortality and longevity of whitebait it may be assumed that this Oct – Dec. phase represents the second breeding in the species concerned and thus the fish that support the peak fishery at the two centres are at the fag end of their life and are subjected to high natural mortality.

Table : 4. *Sex-ratio & Maturity condition (%) of the dominant Whitebait species off Mangalore and Cochin*

Sex ratio and Maturity stage	October/November 1980					
	S. devisi		*S. bataviensis*		*S. buccaneeri*	
	Mangalore	Cochin	Mangalore	Cochin	Mangalore	Cochin
Female	50.5	66.4	54.5	70.4	51.6	64.3
Male	49.5	33.6	45.5	29.6	48.4	35.7
I	–	0.2	4.0	–	–	–
II	–	12.0	23.5	13.7	45.2	–
III	0.5	21.5	26.6	22.3	9.7	5.4
IV	7.6	30.0	10.9	26.2	0.0	50.0
V	1.3	10.8	5.5	24.9	0.0	1.8
VI	57.1	15.9	19.3	9.0	6.4	28.6
VII	33.5	9.6	10.2	3.9	38.7	14.2
No. of fish	1,307	576	443	233	131	56

In the case of *S. devisi* one kg of fish was found to have 265 numbers at both the centres, while for *S. bataviensis* the number of fish per kg was 217 at Mangalore and 219 at Cochin. For *S. buccaneeri* it was 193 at Cochin and 232 at Mangalore where smaller size groups of the species were also caught during the period.

In Table 4, the data on the sex-ratio and the maturity condition of the dominant species are given. It is seen that female fish generally dominated in the catches. Further, fish in gravid and spent condition were predominant, indicating that the fishery at both the centres is based on stock that is breeding for the second time.

Sharing of the catch

No salary is paid to the boat crew employed in the purse seining operations, the sale proceeds of the catch being shared by the share holders/boat owners and the crew as under:

a) Towards capital cost and share holders – 70%

b) The crew, including the share holder who may work on the boat during the fishing season – 30%

The crew, however, will receive only 85% of what is due to them and the rest paid at the close of the fishing season. This is done in order to prevent the fishing crew from changing one boat to another during the fishing season. Those leaving in the middle of the season forfeit the balance amount, which is then shared by the remaining crew.

Disposal, utilization and marketing of the catch

The whitebait catches are auctioned while the

Fig. 4&5. Whitebait being loaded into lorry from the boat at Mangalore for transport to distant markets outside the state.

fish are still on board the vessel at the landing centres. At Cochin most of the catch, mixed with crushed ice, is sent to marketing centres for consumption in fresh condition. At Mangalore, Malpe and other centres in Karnataka, however, only a portion of the catch, about 10%, finds ready market for consumption as fresh fish. This is mixed with crushed ice and transported by lorries to the nearby and far flung markets within and outside the State (Figs. 4 & 5). The remaining 90% of the catch was quickly transported by the same boats that landed the catch or by lorries to the adjacent vast and sandy beaches for sundrying. Thus during the 1980 whitebait fishing season in Karnataka most of the whitebait landed could be sun dried and marketed as dried fish, as sunny weather prevailed during the period (Figs. 6 & 7). Only in a single instance, on 19th November, the catch could not be beach-dried owing to cloudy weather, and the fish amounting to about 70 tonnes had to be converted into fish meal.

Fig. 6. Whitebait being sundried on the beach at Malpe.

Fig. 7. Whitebait being sundried on the beach at Ullal.

Fig. 8. Sun-dried whitebait at Gangoli ready for packing and transport to distant markets outside the State.

Table: 5. *Average price structure (in Rs/tonne) of Whitebait in fresh and beach dried condition at the landing centres in Kerala and Karnataka (Oct/Nov 1980)*

	Kerala		Karnataka					
	Cochin		Mangalore		Malpe		Gangoli	
Month	Fresh	Dried	Fresh	Dried★	Fresh	Dried	Fresh	Dried
Oct 1980	1125	–	1018	4250	1400	3850	1150	4500
Nov 1980	1012	–	944	4250	–	3850	–	4500
Average	1069	–	981	4250	1400	3850	1150	4500

★Price of dried fish at Ullal.

After letting the fish dry for about fortyeight hours, it is heaped over coir mats for packing in gunny bags for storage and marketing (Fig. 8). By this process, a tonne of dry whitebait is obtained from about three tonnes of fresh fish. The dry fish is sent to markets in Kerala, Tamilnadu and Orissa where there is great demand for the product. A good quantity of this dry fish is also exported to Sri Lanka through Tuticorin Port. Local demand for dry whitebait in Karnataka is mostly during the south west monsoon period.

Price structure

The monthly variations in the prices of fresh and sundried whitebait per tonne at the different purse seine landing centres are given in Table 5.

It is seen that the average price per tonne of fresh fish was Rs 1,069 at Cochin, Rs 981 at Mangalore, Rs 1,400 at Malpe and Rs 1,150 at Gangoli, whereas the average price of beach-dried whitebait was Rs 3,850 at Malpe, Rs 4,250 at Mangalore (Ullal) and Rs 4,500 at Gangoli. Based on the average price structure for the fresh and dried fish at Cochin and Mangalore the estimated value of the whitebait catch by purse seine at the above two centres alone during the period October – December 1980 works out to 0.27 million and 4.84 million rupees respectively.

General considerations

From the foregoing account it is clear that with the introduction of purse seiners exploitation of whitebait resource in these areas has commenced in an increasing manner and great scope exists for enhanced landings of the fish by purse seine fishery during the peak months of abundance (October – December) along the west coast. However, due to the limitations of the infrastructure facilities for handling, storage, transport and marketing, the concentration of large number of purse seiners at a single base will bring about serious management problems.

Besides, such a situation being a disincentive for realising the full potential of the purse seine fishery, they also create serious glut conditions in the market resulting in unremunerative prices. But for the facility to beachdry bulk (90%) of the catches during 1980 season, and to market them at fairly remunerative prices, utilization of such a large catch would have posed very serious problem. Cloudy weather conditions during the season and the absence of clean sandy beaches at the landing sites are two of the serious constraints in this method of utilization of the whitebait resources.

It is, therefore, necessary to redeploy the purse seiners engaged in whitebait fishery, at the major centres spread over Karnataka coast and to develop simultaneously at those bases infrastructure facilities capable of handling, storing, processing and marketing, realising the full potential of the purse seine fishery, in order to obtain remunerative prices for the huge whitebait catches landed during a short period of about three months.

Based on the biological considerations too, increased and judicious exploitation of this stock, which has completed one breeding cycle and is at the fag end of its life during the period of its abundance along the west coast (October – December), particularly along the Karnataka coast, may be desirable, as this size group may no longer be available on account of the very high natural mortality that the fish may be subjected to beyond this size.

DISTRIBUTION OF THE INDIAN MACKEREL, *RASTRELLIGER KANAGURTA* (CUVIER) ALONG THE COASTS OF INDIA IN 1979 AND 1980*

Introduction

Mechanisation of the exploitation of the pelagic fishery resource in the country is slowly setting in. It is imperative in such a situation to identify areas and seasons of abundance of the resource to plan economic and judicious dispensation of the effort required to exploit them. Areas of good catches and times of abundance of the Indian mackerel, *Rastrelliger kanagurta* (Cuvier) along the Indian coasts for the year 1979 and 1980 are presented here, as an addition to the data for 1978 already published (*Mar. Fish. Infor. Ser. T & E Ser.*, No. 8: 1-11, 1979).

Annual production

The total landings of the mackerel in India from its pinnacle of 2,04,575 tonnes in 1971, gradually declined in the following 3 years to a poor figure of 37,462 t in 1974, whence except a small dip in 1977 it increased to 85,233 t in 1978. This upward trend subsequently reversed in the following years and the landings decreased to 71,514 t in 1979 and 55,279 t in 1980 (Fig. 1).

Mackerel in relation to total marine fish production

The country recorded 14,03,607 t of marine fish in 1978. Of this, the mackerel formed 6.1%. In 1979, the total marine fish catch in India was 13,88,380 t of which the contribution by the mackerel was 5.2%. The total marine fish catch in the country in 1980 was only 12,49,837 t, 4.4% of which being mackerel (Fig. 1).

Mackerel landings in the east and west coast of India

The landings in the east coast down to Kanyakumari in 1978 was 4,049 t forming 4.8% of the all-India total. In the west coast from Kanyakumari up, the landings were 81,184 t forming 95.2% of the year's total. In 1979, the catch and the corresponding percentage in the east and west coasts were 6,129 t forming 8.6% and 65,385 t forming 91.4%. In the subsequent year, the catch and its percentage in the east coast have increased further to 13,187 t and 23.9% respectively. In the west coast the catch concurrently reduced to 42,092 t forming only 76.1% (Fig. 1). When the landings and their percentages significantly increased during 1978 - 80 period in the east coast, in the west coast it greatly dwindled.

Distribution of the mackerel along the states of India

West Bengal

As in 1978, there was no mackerel landing along this coast during 1979 and 1980 also.

Orissa

The mackerel catch in Orissa in 1978 was 196 t, forming only 0.2% in the country's total landings. It, however, formed 0.5% in the state's annual marine fish catch. In 1979, the mackerel landings in the state increased to 306 t (Fig. 1). In the country's total mackerel production of the year the state's share was 0.4%. In the total marine fish landings of the state in the year, the mackerel contributed to 0.6%. Subsequently, there was a decline in the mackerel catch in 1980, dropping the landings to 265 t. However, in the country's total mackerel catch for the year it formed 0.5%, and in the state's marine fish landings it accounted for 0.7%. In spite of the reduction in the catch, the percentage of the mackerel in 1980 at both levels showed improvements (Fig. 1).

Within the state, as in 1978, no mackerel occurred along the coast of Balasore district in the north (Fig. 2 - or 1) in 1979 and 1980 also. In 1978, high catches accounting for 55.5% of the state's total occurred in Puri and northern part of Ganjam coasts. The southern area of Ganjam coast accounted for the remaining 44.5%. In 1979, the southern coasts of Ganjam district (Fig. 2 - or 3) accounted for 74.5% of the mackerel catch. Puri and northern coasts of Ganjam district (Fig. 2 - or 2) had the rest. In 1980, again more or less the 1978 condition existed with 58.9% of the landings occurring along the coasts of Puri and northern part of Ganjam district and only 41.1% occurring along the coast of the southern part of Ganjam district.

Andhra Pradesh

The mackerel landings in this state in 1979 and 1980 were 2,621 t and 6,203 t respectively (Fig. 1) against 2,520 t of 1978. There was thus an increase of about 2.4 times in the landings in 1980 over that of the preceeding 2 years. The percentages of the mackerel landings of the state in the country's total in

*Prepared by A. Noble, in association with the staff of Fishery Resources Assessment Division.

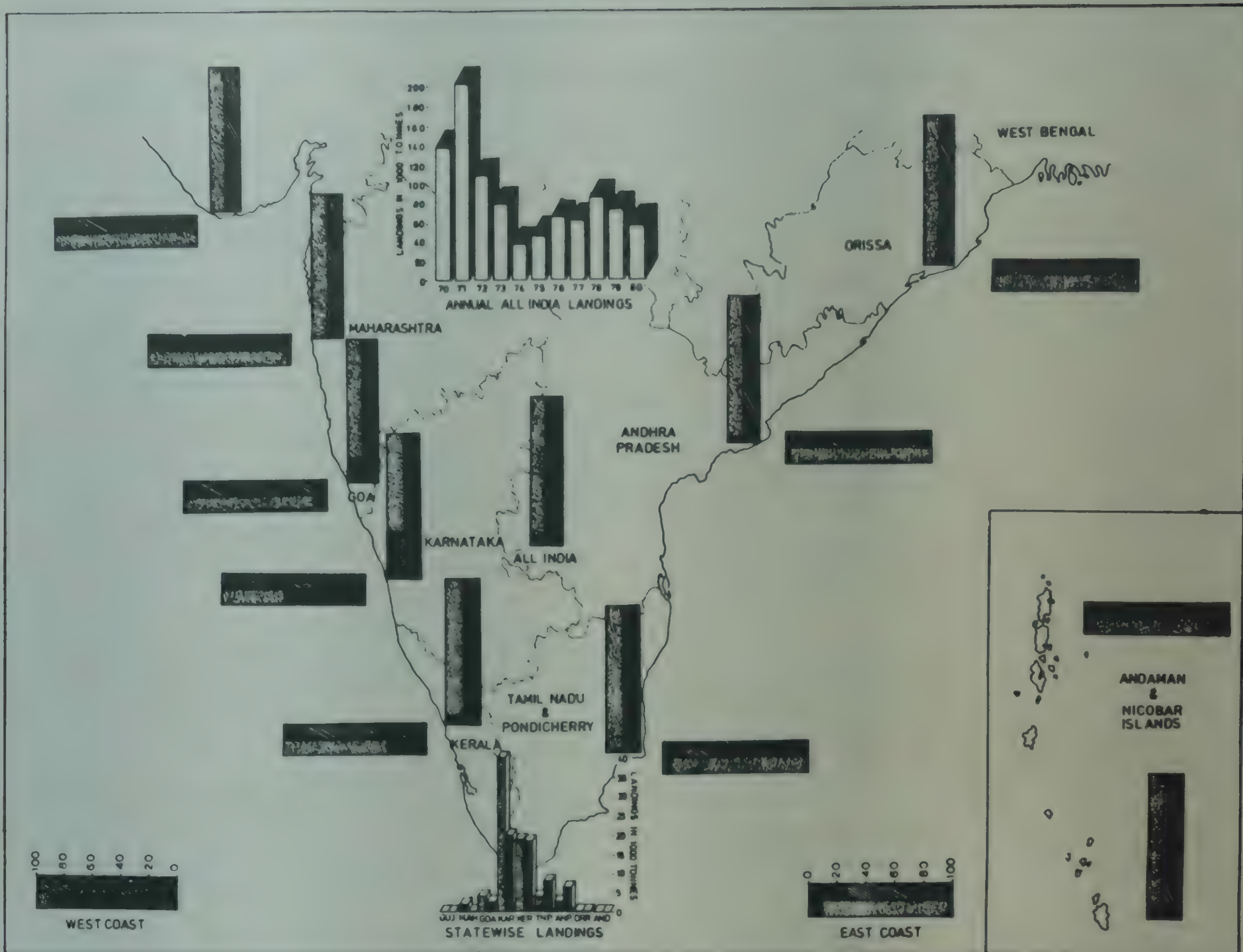


Fig. 1. All India annual landings of mackerel during 1970–80, statewise landings in 1979 and 1980, statewise and coastwise percentage landings of mackerel in the all India total (horizontal bars), and percentage of mackerel in the marine fish production (vertical bars). The stippled bars stand for 1979 and the striated for 1980.

1978 and 1979 were 3.0 and 3.7 respectively. The increase in the landings here in 1980 was so substantial as to register a high value of 11.4% in the all-India annual catch. In the state's marine fish landings, the mackerel formed 3.1%, 2.9% and 5.3% in 1978, 1979 and 1980 respectively (Fig. 1).

There was no mackerel catch along the Srikakulam coast in the northern most part of the state in 1978. In 1979 and 1980, respectively 27.8% and 29.1% of the mackerel landed in the state, came from this area (Fig. 2 - Anp. 1 & 2). In fact, the increasing trend seen in the catches along the southern Orissa coast reached a climax in the Srikakulam coast followed by a little fall along the Visakhapatnam coast (Fig. 2 Anp. 3). The Kakinada coast in East Godavari district (Fig. 2 Anp. 4) had the peak landings accounting for 46.0%, 53.4% and 33.0% of the state's total in 1978, 1979 and 1980 respectively. In fact, three-fourth (77.8%) of the mackerel landings in 1979 occurred in the northern half of Andhra Pradesh stretching from Srikakulam to East Godavari coast. The landing in the southern half was 47.8% in 1978. It, however, reduced to just 22.2% in 1979, and 34.2% in 1980. In the southern half of Andhra Pradesh, the important place for mackerel landings was the Guntur-Prakasam area (Fig. 2 - Anp. 7).

In 1978, mackerel in the state actually occurred in 2 clusters of places, the first one along the coasts of Visakhapatnam and Godavari districts and the second along the coasts of Guntur, Prakasam and Nellore. In 1979 and 1980, there were 3 areas along the coast where the mackerel catches were comparatively good namely, the northern most part of Srikakulam district, the East Godavari district, and the Guntur - Prakasam districts. Along the coasts of Visakhapatnam (Fig. 2 - Anp. 3), West Godavari - Krishna (Fig. 2 - Anp. 5 & 6) and Nellore (Fig. 2 - Anp. 8 & 9) districts the mackerel catches were poor

in 1979 and 1980.

Tamil Nadu and Pondicherry

The mackerel catch here was 1,632 t in 1978. In 1979, the catch increased to 3,945 t and in 1980 it further rose to 7,674 t (Fig. 1). As in Andhra Pradesh, there was an increasing trend in the mackerel landings along Tamil Nadu - Pondicherry coast also.

The percentage landings of the mackerel in the coast in respective all-India annual total mackerel landings were 1.9 in 1978, 5.5 in 1979 and 14.1 in 1980 (Fig. 1). In the state's total marine fish catches, the mackerel landings formed 0.7% in 1978, 1.6% in 1979 and 3.4% in 1980 (Fig. 1).

Immediately after the poor mackerel zone of Nellore coast in Andhra Pradesh (Fig. 2 - Anp. 9), the catch in Tamil Nadu coast in the northern most part of Chengalpattu district (Fig. 2 - Tnp. 1) was slightly better. After a small drop along the rest of the coast of this district (Fig. 2 - Anp. 2 to 4) the catch was comparatively good in the South Arcot and Pondicherry area (Fig. 2 - Tnp. 5). The landings in Thanjavur - Pudukottai area (Fig. 2 - Tnp. 9) in 1980 were very high (26.3%). In 1978 also, the area from South Arcot to Thanjavur districts accounted for 47.0% of the total mackerel landings of the Tamil Nadu - Pondicherry coast.

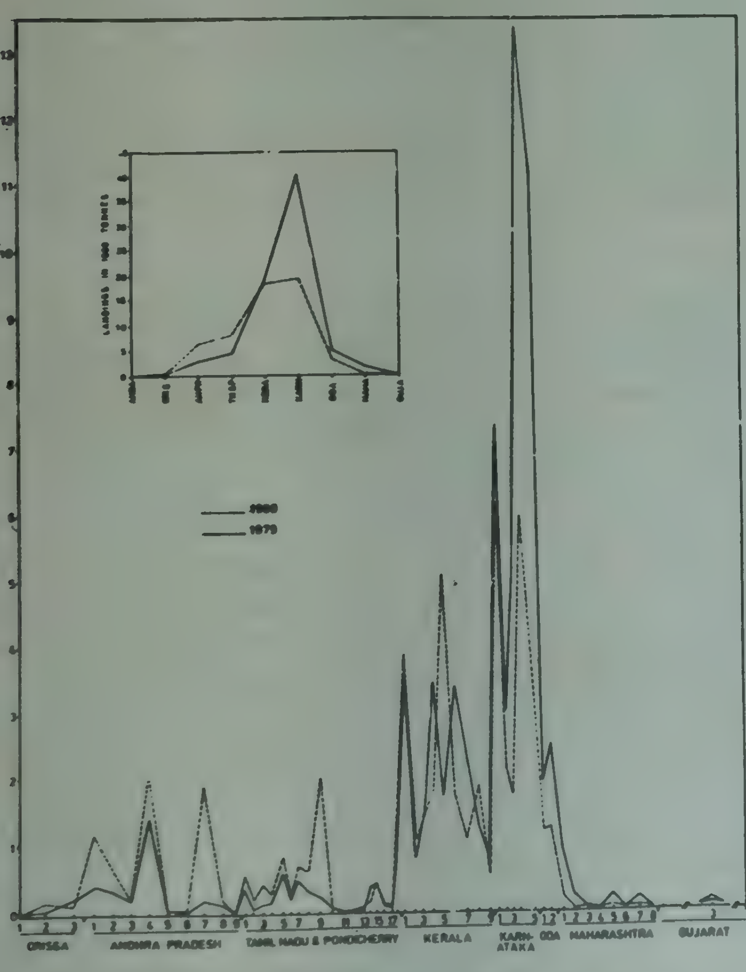


Fig. 2. Distribution of mackerel landings within the states in 1979 and 1980.

Next area of good mackerel landings in the coast of Tamil Nadu was from the south end of Ramanathapuram to Kanyakumari districts contributing to 42.0% of the State's annual landings in 1978. In 1979 and 1980, Thirunelveli coast (Fig. 2 - Tnp. 14 & 15) had better catches in comparison to the Ramanathapuram coast (Fig. 2 - Tnp. 10 to 13) where the catches were very poor. All through the Tamil Nadu - Pondicherry coast from Chengalpattu district in the north to Thanjavur district in the south (Fig. 2 - Tnp. 1 to 9) the catches in 1980 were better than that of 1979. Along Ramanathapuram and Tirunelveli coasts (Fig. 2 - Tnp. 10 to 15) the 1979 catches were almost the same to that of 1980.

Kerala

In contrast to the ascend in the landings along the east coast, in the west coast beginning with Kerala State in the south, the landings descended during 1978-80 period.

The mackerel catch in Kerala State was 25,917 t in 1978, declining to 18,585 t in 1979 and 18,474 t in 1980 (Fig. 1).

The mackerel landings in Kerala in 1978 formed 30.4% of the all-India catch. In the following year it reduced to 26.0% but regained to a good position with 34.0% in 1980 (Fig. 1). In the state's total marine fish landings, the mackerel contributed to 7.0% in 1978, 5.6% in 1979 and 6.6% in 1980 (Fig. 1).

Within the state, the southern most part of Trivandrum coast (Fig. 2 - Ke. 1) had some amount of mackerel in all the years under review here. In 1978, even though it accounted only for 4.4% of the state's mackerel landings, it elevated to 18.9% in 1979 and 20.8% in 1980, similar to the trend seen in the east coast of the country. In 1980, in the northern coast of Trivandrum district and some contiguous portions of Quilon district (Fig. 2 - Ke. 2) the landings were poor. Along the coasts of Alleppey district to the southern part of Cannanore district (Fig. 2 - Ke. 3 to 8) the catches were comparatively high. On account of the operations of purse seiners in and around the coast of Ernakulam district (Fig. 2 - Ke. 5) there were exceptionally good landings at Cochin Fisheries Harbour. The Alleppey - Ernakulam - Trichur (Fig. 2 - Ke. 5) region thus had better catches than the Malapuram - Kozhikode - Cannanore area (Fig. 2 - Ke. 7 & 8) in 1980. In 1979, the Alleppey - Ernakulam - Trichur region had only lower landings. But the landings in Trichur - Malapuram section (Fig. 2 - Ke. 6) were very high. In the northern part of the state, along Cannanore coast (Fig. 2 - Ke. 9) the catch was low in 1979 and 1980. However, the mackerel was abundant along the Malabar coast of Malapuram - Cannanore districts (Fig. 2 - Ke. 7 to 9) in 1979, where 62.0% of the sta-

te's mackerel landings were accounted for.

Karnataka

Maximum mackerel landings of the country in 1978 came from this state, and it amounted to 50,704 t accounting for 59.5% of the total annual all-India catch. In 1979, the landings reduced to 40,084 t, yet contributing to the bulk (56.1%) of the total of the country. The landings subsequently crashed to a low level of 19,634 t in 1980, forming only 35.5% in the all-India catch for the year (Fig. 1). Thus the declining trend seen along the Kerala coast was reflected much more conspicuously in Karnataka during 1978-80 period.

The mackerel fishery is very important to the Karnataka state where it forms a sizable chunk in its total marine fish production. In 1978, the mackerel formed 33.2% in the state's total marine fish landings. In 1979, this percentage diminished to 31.7, and in 1980 it lowered further to 17.5 (Fig. 1).

In and around Mangalore (Fig. 2 - Ka. 1) the catches were good during 1978-80 period. North of Mangalore from Mulki to Kidiyoor (Fig. 2 - Ka. 2) the catch generally was low. The landings from Malpe to Coondapur (Fig. 2 - Ka. 3) in 1978 were very high, to the extent that it alone formed 32.4% in the state's annual total landings of the mackerel. In the following 2 years the landings here were lesser. Though it was better in comparison to the Mulki - Kidiyoor area in 1979, in 1980 it was poorer. Towards north, from Gangoli to Sasithal, the catches in 1978 were poor. However, in 1979, the catch in this area (Fig. 2 - Ka. 4) was very high forming 33.5% of the state's total. In 1980 also this region topped in the landings with 30.4% on its side. From Bhatkal to the north, the catches formed only 16.7% in 1978, increasing to 27.9% in 1979 and dropping to 18.8% in 1980 (Fig. 2 - Ka. 5).

The share of Dakshina Karnataka coast in the state's mackerel landings in 1978 was about 80.0%, the remaining 20.0% being from the coast of Uttara Karnataka. In 1979, and 1980, the catches in Dakshina Karnataka were respectively to the tune of 72.0% and 80.0% of the state's total landings, the rest being fished from Uttara Karnataka.

Purse seine operations along the coast of the state were rather wide spread especially from the bases at Mangalore, Malpe, Gangoli, Bhatkal and Karwar, with the traditional gear *Rampani* still in vogue.

Goa

The mackerel landings in Goa in 1978, 1979 and 1980 were 3,371 t, 4,391 t and 2,446 t forming 4.0%, 6.2% and 4.5% respectively in the respective annual total mackerel landings of the country as a whole (Fig. 1). In the territory's total marine fish landings, the mackerel formed 12.4% in 1978, 17.3% in 1979 and 10.0% in 1980 (Fig. 1).

The bulk of the catch in the territory came from its northern sector in 1978. In 1979 and 1980, the catch was more or less uniformly spread out, though in the northern region, it was slightly better (Fig. 2 - G. 1 & 2).

Purse seine continued to be the major gear operated along the coast from base at Panaji.

Maharashtra

The mackerel catch in Maharashtra state was 787 t in 1978. It increased to 1,455 t in 1979 but declined to a very low value of 288 t in the year next. In these 3 years, the mackerel landings in the state formed respectively 0.9%, 2.0% and 0.5% in the all-India total mackerel landings of the corresponding years (Fig. 1). In the marine fish landings of the state, the mackerel formed only 0.3% in 1978, 0.5% in 1979 and 0.1% in 1980 (Fig. 1).

The Ratnagiri coast (Fig. 2 - Ma. 1 & 2) adjacent to the Union Territory of Goa had 29.0% of the state's total mackerel landings to its credit in 1978. In 1979, this area had 77.0% catch, and in 1980 the percentage increased to 82.0. In 1979 and 1980, there were landings of respectively 13.0% and 14.0% of mackerel in the northern most part of the coast of Ratnagiri district (Fig. 2 - Ma. 5). The landings in Bombay coast in 1978 were 65.0% of the year's total catch. However, it reduced to just about 9.0% in 1979 and dwindled further to 4.0% in 1980 (Fig. 2 - Ma. 7).

Gujarat

There was no mackerel catch along this coast in 1978. However, 35 t of mackerel were landed in the state in 1979. (Fig. 1) along the Bhavanagar – Porbandar area (Fig. 2 - Gu. 3). In 1980, 112 t of mackerel were caught from this area.

The mackerel catch in Gujarat formed only 0.2% in the country's total mackerel production in 1980. In the state's marine fish catch it contributed to only 0.06%. In 1979, the landings were so poor in quantity as to register any significant percentage.

Andaman and Nicobar Islands

The mackerel catch in this area was 106 t in 1978. It reduced to 92 t in 1979 but increased to 112 t in 1980 (Fig. 1).

In 1978 and 1979, the landings formed only 0.1% of the annual totals in the country. In 1980, however, it increased to 3.0%. In the island's marine fish lan-

dings, the mackerel played an important role as it formed 6.7%, 5.3% and 10.2% respectively in the three years.

Lakshadweep

As usual there were no mackerel landings in these islands during the years under consideration.

Seasonal distribution of the mackerel

The season of 1978 which had the highest landings in September (26.2%) and October (28.7%) continued up to May 1979. During January – May 1979, the percentages of the monthly catch ranged between 5.4 in February and 11.0 in April (Fig. 3). In June the percentage fell to 2.9 and reached 0.4 in August. In September, with the commencement of 1979 season, the percentage rose to 9.9. In the subsequent 2 months, the monthly percentage landings were 19.9 and 16.2 respectively. Further it again reduced to 5.1% in December. In 1980 (Fig. 3), during January – March the monthly percentages ranged between 7.5 of February and 10.0 of January. After a fall in April (4.4%) it again rose to 11.5% in May 1980. As in the previous year the catch fell in June to 2.4% and reduced further to 1.2% by August. The mackerel season for the year 1980 commenced in September with 14.3% of the year's total landings and remained more or less the same in magnitude for the rest of the year within a range of 10.7% to 14.9% per month. In fact, December had the highest percentage (14.9) for 1980.

As the bulk of the landings occur along the west coast of India, the seasonal distribution on all-India level is only a reflection of what is happening in the west coast (Fig. 3).

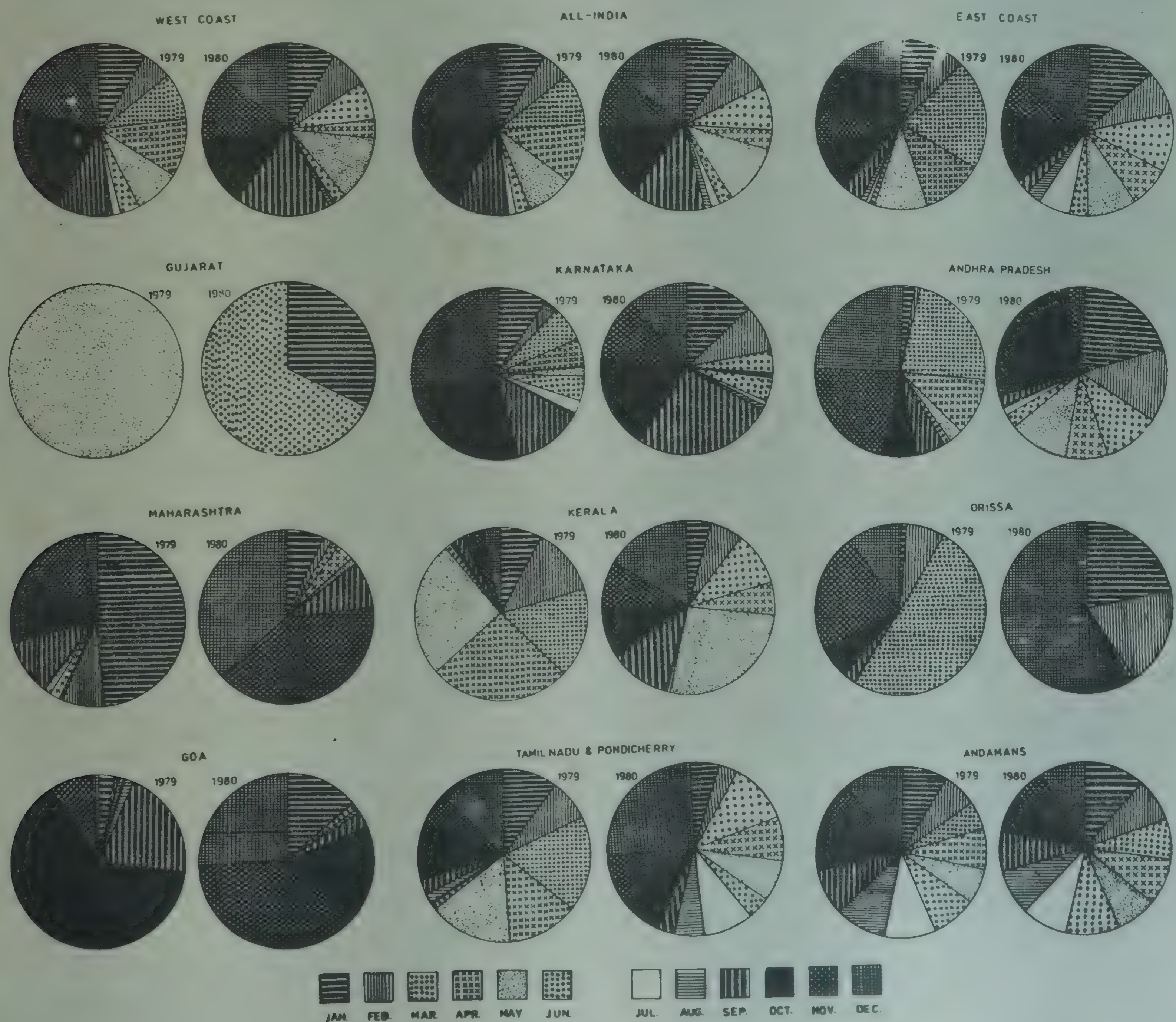


Fig. 3. All India, statewise and coastwise seasonal distribution of the mackerel landings in 1979 and 1980.

The picture in the east coast (Fig. 3), nevertheless, is quite different. In 1978, the maximum landings along the east coast occurred in February (34.5%) and March (29.9%). In 1979 (Fig. 3), it was the highest in March (20.7%) and more or less good in the following 2 months registering respectively 11.8% and 10.0% of total landings. As in the west coast, the landings in June - August were very low (0.8 - 1.2%) in the east coast also. In October - December 1979, the catches were better, the monthly percentages, ranging from 9.0 to 16.8. The percentage in December was the highest. Subsequently in 1980 up to May, the catches were only moderate with 8.1% to 12.9% range in monthly values. This was followed by low values during June - September (2.9 - 6.1%). As in the west coast the catch was important here in October in this year with the percentage at 14.3. After a lull in November (5.5%), the landing went up to 16.0% in December which incidentally is the year's peak month in mackerel landings along this coast.

Statewise seasonal distribution in the mackerel landings

Orissa

In 1978 the maximum landings in the state occurred in February (35.3%) and March (23.1%). There was a secondary peak in November (17.3%). In the next year the major peak occurred in March when 50.3% of the state's catches were landed (Fig. 3). As in the previous year, the secondary peak occurred in November (22.6%). This was more or less the story of the southern coast of Ganjam district (Fig. 4 - Or. 3) from where the state's major mackerel contributions came. Deviating from this pattern, the landings in January and February 1980 were respectively only 21.9% and 18.5% having the peak shifted to December when 55.5% of the year's catch were recorded. It was a projection of the bulk landings in the north along Puri and northern coast of Ganjam districts (Fig. 4 - Or. 2).

The mackerel was absent in the state during May - September in 1978 and April - July in 1979. In the next year it was practically nil during March to September period (Fig. 4 - Or. 1 to 3).

Andhra Pradesh

The bulk of the landings in 1978 occurred here in February (52.1%) and March 42.5%). There was no mackerel catch in May and June and it was extremely poor for the rest of the year with the percentages ranging between 0.2 to 2.0. In 1979 (Fig. 3), the catch was good in March when 22.6% of the fish in the year were landed. Subsequently during June - August, the fishery was practically absent. In November and December, the catches again shot up to respectively 22.1% and 24.7%. This tempo was carried over to

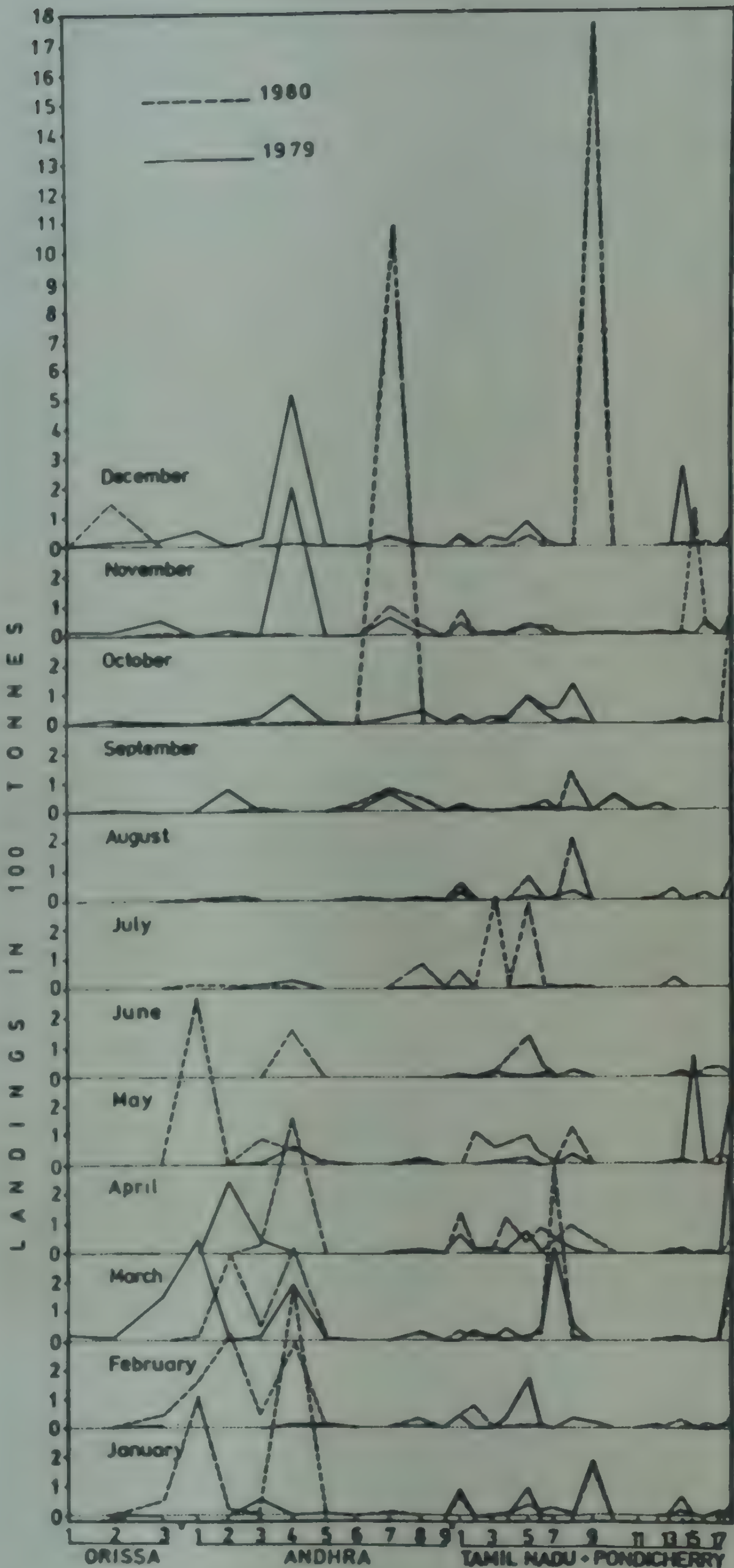


Fig. 4. Seasonal distribution of mackerel landings within Orissa, Andhra Pradesh and Tamil Nadu-Pondicherry states in 1979 and 1980.

January 1980 (Fig. 3) when 19.7% of the year's landings were accounted for. Subsequently the landings up to May was appreciably good in quantities resulting in the monthly percentages to range between 7.9 to 13.2. The catch was the highest in the year in October with 27.2%. Unlike the previous years, the mackerel landings were much less in the state during June - September also. The peak landing in October 1980 was due to an unusually high catch in the Guntur - Prakasam area (Fig. 4 - Anp. 7).

The fishery was good in the state from the coast of Srikakulam district in the north to East Godavari coast (Fig. 4 – Anp. 1 to 4) during January – May and in the remaining southern part of the state (Fig. 4 – Anp. 6 to 8) it was important during September – December.

Tamil Nadu and Pondicherry

The mackerel landings in Tamil Nadu - Pondicherry coast ranged in January – April between 10.9% to 15.4% of the annual total catch in 1978. The highest percentage during this period occurred in April. The percentages were 4.1 and 11.0 in May and June respectively. The catches were low during July – September with the monthly percentages ranging between 1.8 and 4.8. In October, the catch became 7.7% in the annual total, followed by 4.9% in November and 8.7% in December. In 1979, the bulk of the mackerel catch along the coast was accounted for in March with 17.6% of the fish (Fig. 3). In April and May, the landings had fallen to 13.3% and 15.8% respectively. During June – September the catches were very low, the percentages lying between 0.2 and 2.8. In October, the landings accounted for 10.5%, followed by 6.2% in November and 12.3% in December. In the beginning of the year also the landings were more or less of this order, apportioned as 10.5% to January and 7.8% to February. In January and February 1980 (Fig. 3), the percentage landings in Tamil Nadu – Pondicherry coast were 5.6 and 3.4 respectively to the year's total. During March – May the catches improved a little, ranging between 7.1 and 11.3. During June – November period the catches varied between 3.1% to 9.4%. December 1980 had the maximum landings to the tune of 25.5% of the annual total.

In Tamil Nadu – Pondicherry area, the coast of South Arcot, Pondicherry, Karaikkal and Thanjavur had the highest catch in June 1978. It was good in February – March and also October. Along the coasts of Tirunelveli and Kanyakumari districts, the season occurred during December – April, with the maximum in April. In 1979, the catch along the South Arcot, Pondicherry, Karaikkal and Thanjavur area (Fig. 4 – Tnp. 5 to 7) was the highest in March and good in October. Along Tirunelveli and Kanyakumari coasts (Fig. 4 – Tnp. 13 to 18) the catches were good in March – May. In 1980 also, the catch in general along the South Arcot, Pondicherry, Karaikkal and Thanjavur area was the highest in March. Along Tirunelveli and Kanyakumari coasts the mackerel landings were good during October and November. Because of unusually heavy mackerel catches, in Thanjavur – Pudukottai region (Fig. 4 – Tnp. 9) the landings registered substantial increase in December.

Kerala

The peak landings occurred in this state in September forming 33.1% of the annual total catch in 1978. In October, the landing was good (15.0%). During January – April, the catches were moderate except in March when 12.3% of the year's total were caught. The landings were meagre during July – August. In 1979 (Fig. 3), the fishery that continued from the previous year heading to the peak in April (26.4%) and an equally important catch in May (25.7%). After the usual off-season during June – August, the landings remained low during September-

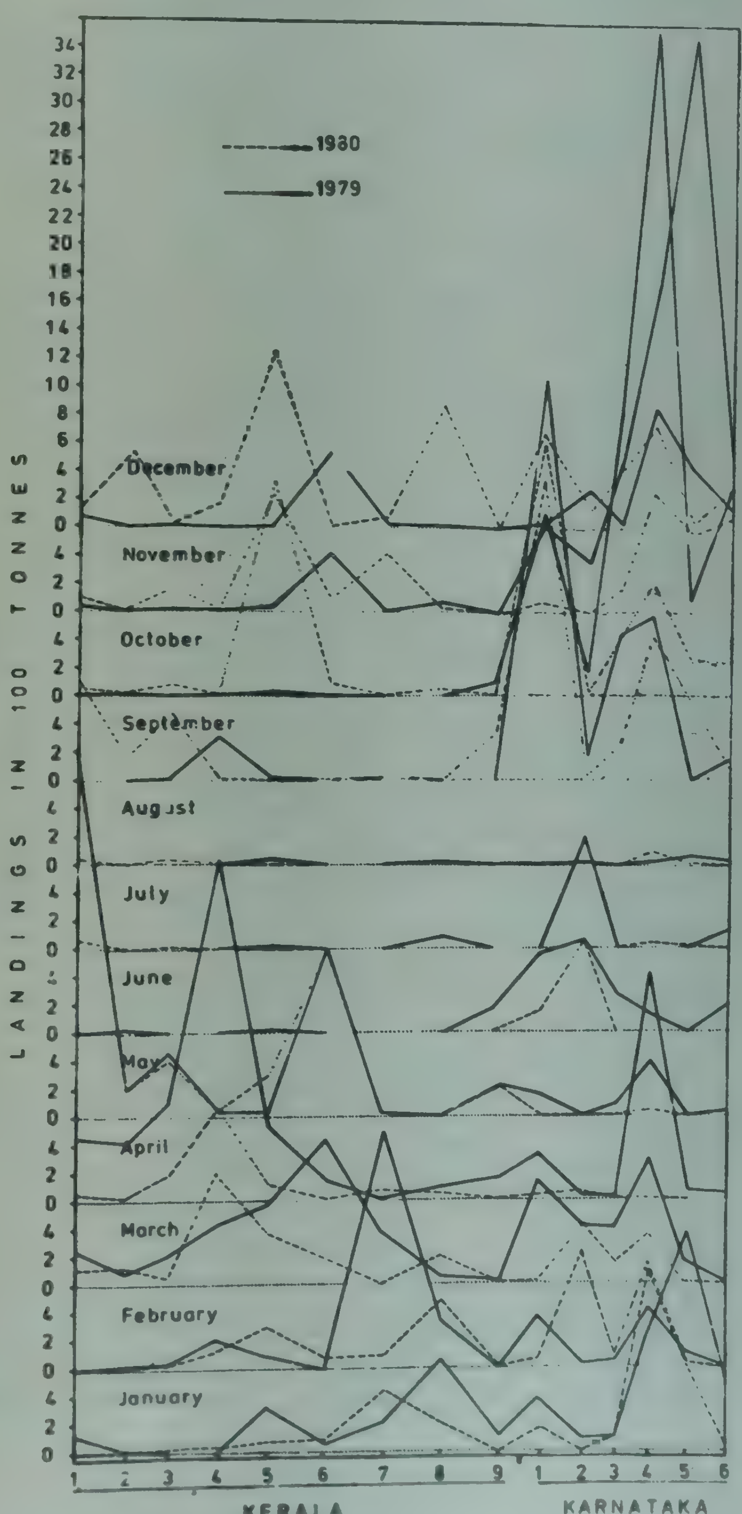


Fig. 5. Seasonal distribution of mackerel landings within Kerala and Karnataka states in 1979 and 1980.

– December within a monthly range of 0.9% to 3.4% only. This low landings limped through the beginning of 1980 also up to April. In May, there was a sudden spurt in the landings resulting in a high percentage of 26.7 of the annual total landings. Subsequently the fishery was almost absent during June – August. The 1980 season commenced in September when 11.0% of the fish were landed. In October and November the percentage of landings were 9.6 and 8.6 respectively only. But December realised 16.2% of the year's catch (Fig. 3).

In Kerala along the southern most part of Trivandrum coast, the landings were exceptionally high in May in 1979 and 1980 (Fig. 5 – Ke. 1). In 1978 also, the highest landings here were recorded in May. Along the coast of Ernakulam district and nearby areas of neighbouring districts, the fishery was excellent in September and good in February – April in 1978. Along the Malapuram – Kozhikode – Cannanore coast, the season of 1978 started in September with high catches and it was good in October also. The landings in January – March period of the year here were only moderate. The catch as already stated earlier was very high in the southern most part of the Trivandrum coast in May of both 1979 and 1980. Apart from this, in 1979, good catches were noticed along Alleppey coast (Fig. 5 – Ke. 4) in April, Trichur – Malapuram area (Fig. 5 – Ke. 6) in March and May and Malapuram – Kozhikode area (Fig. 5 – Ke. 7) in February. Such high catches were noticed in 1980 only in Trichur – Malapuram area in May, and Ernakulam and the neighbouring areas in October – December. The catch in Kozhikode – Cannanore area (Fig. 5 – Ke. 8) in December is also noteworthy. In short, the Alleppey – Ernakulam – Trichur region (Fig. 5 – Ke. 5) and the Malapuram – Kozhikode – Cannanore region (Fig. 5 – Ke. 7 & 8) showed the same seasonal trends in 1979 and 1980.

Karnataka

In Karnataka, in 1978, the mackerel season of the previous year lingered during January – April period. During May – August the fishery was practically absent. However, the season of 1978 commencing in September with good catches had the highest landings in October when 38.1% of the year's landings were recorded. This fishery as usual extended to the first half of 1979. The season of 1979 in turn started in September and the peak landing occurred in October with 26.0% of the total. In November, the landing was 23.9%. But by December it dwindled to 4.4%. The same story was repeated in 1980 also though the total landings in the state were comparatively much low. The fishery as usual started, in September, and bagged the highest landing (28.1%) of the year. After September, the catches gradually diminished from 13.9% of October to 11.8% of December.

Mangalore coast in Karnataka had very high landings in October – November in 1978 The landings were high along the other regions of the Dakshina Karnataka coast up to Coondapur during October – December. The highest mackerel landings of the year in the state occurred in October along Malpe – Coondapur region. Along the Uttara Karnataka coast good catches were noticed in September, October and December. In 1979, the landings along Mangalore coast (Fig. 5 – Ka. 1) were good in September and October. Along Malpe – Coondapur region (Fig. 5 – Ka. 3) it was good in September – November. Around Gangoli (Fig. 5 – Ka. 4) there were good landings in April and also September – December. In 1979, the highest catch in the state occurred here in October. Along the coast of Uttara Karnataka (Fig. 5 – Ka. 5 & 6) there were good mackerel catches in January and also October November. The highest monthly landing in the state in 1980 appeared in Mangalore in September. The landing in the Malpe – Coondapur coast was poor and around Gangoli it was better in January and September.

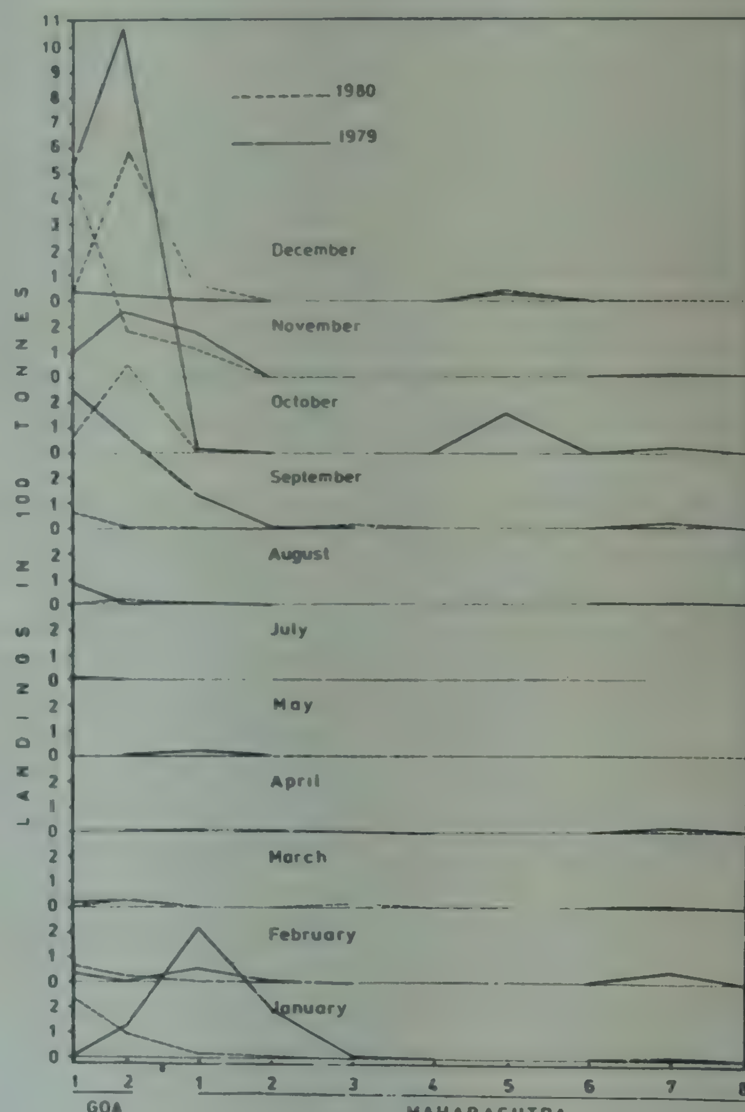


Fig. 6. Seasonal distribution of mackerel landings within the Union Territory of Goa and the state of Maharashtra in 1979 and 1980.

Goa

Good catches of mackerel were recorded here in September – December in 1978 with 32.2% occurring in October and the peak of 34.6% occurring in November. This fishery further continued in a low tone up to March 1979 (Fig. 3). The fish disappeared totally in the following quarter and appeared only sparsely in the next 2 months. The season for 1979 commenced in September and landed 20.6% of the year's total. The highest landings in the year (63.8%), however, occurred in October. During November 1979 to January 1980, the coast had only moderate landings, subsequently becoming poor till March. During April – July, the mackerel as usual was absent. In August – September the mackerel again started appearing and the catches during October – December were good with the peak monthly percentage of 38.6 occurring in November (Fig. 3).

Region-wise (Fig. 6 – Go. 1 & 2) the pattern of seasonal distribution in the mackerel was almost the same as that of the territory as a whole.

Maharashtra

In Maharashtra, although the mackerel landings occurred all through the year in 1978, November recorded the highest landing of 46.8%. In the first half of 1979, the landings occurred up to May and after a break in June – July occurred again in August – December (Fig. 3). The primary peak in the year was in January with 48.8% catch and the secondary peak in October with 13.5%. The landings in November was in par with that of October. In 1980, the mackerel was landed up to May in the first part with a small peak of 7.0% in January. After an absence during July – August, there was a landing of 8.7% of the year's total in September. The fish was absent again in October, but reappeared in November and December holding 39.9% and 36.8% respectively of the annual catch (Fig. 3).

In the state along Ratnagiri coast, the fishery commenced with high catches in October in 1978. In November also the fishery was good. The arrival of mackerel in Bombay was moderate in September but heavy in November and December. In 1979, the landing was the highest in January along the southern half of the Ratnagiri coast (Fig. 6 – Ma. 1 & 2). As in 1978, good landings occurred in the southern most part of Ratnagiri coast (Fig. 6 – Ma. 1) in November – December 1980. There was unusually good mackerel landing in the northern most region of Ratnagiri district (Fig. 6 – Ma. 5) in October 1979. In December of 1979 and 1980 also some mackerel were landed here though it was conspicuous by its absence in the same month in 1978.

Gujarat

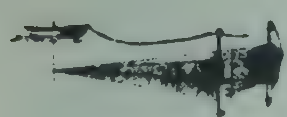
Gujarat had no mackerel landing in 1978, and what little available in 1979 occurred in the month of May (Fig. 3). In 1980, two-third of the catch occurred in March and the rest in January.

Andaman and Nicobar Islands

A protracted fishery was observed in these waters where the mackerel landings were more or less equally distributed among all the months of the year ranging from 4.7% in September to 11.3% in December in 1978, 5.4% in March to 10.9% in December in 1979, and 6.6% in October to 11.5% in January in 1980.

General remarks

In the southern region of Tamil Nadu state around the peninsular India the mackerel seasons were almost similar to west coast. The South Arcot – Pondicherry – Karaikkal – Thanjavur area, having a protracted season, almost commensurate with that of Andaman and Nicobar Islands, appears to have more or less an intermediate status between the west and east coast in the seasonal distribution of the mackerel fishery in Indian coasts.



CRISIS IN FISHERIES HARBOUR, COCHIN*

Suspension of fish landings at the harbour

First week of January 1982

In the Cochin Fisheries Harbour, controlled by Cochin Port Trust, nearly 5,000 people are employed in various operations connected with the handling of fish catches from an average of 300 fishing vessels (42′ purse seiners – 40, 32′ purse seine carriers – 80, 24′ gill net boats – 50 and 32′ shrimp trawlers – 130). Fish worth about Rs. 8.0 lakhs are handled at the harbour daily. After the berthing of the vessels the catch is sold straight away or after unloading, by auction and the fish sold thus is packed with ice and removed from the harbour quay by the merchants. Each category viz: the owner, the agent or the merchant have freedom to engage their own labour for the work connected with the fish handling at the harbour. To have an effective control on the proper handling of fish, the harbour authorities have imposed some restrictions for the entry of merchants and persons connected with the trade. Licences for carrying out these works are being granted by the harbour authorities on payment of specified fees and this has been the practice from the time of the commissioning of the harbour in December 1978.

At present there are about 650 licenced merchants, who participate in auction and remove the fish by all modes of conveyance except by bicycles. Each one of them is provided with 3 entry passes; one for himself and the other two for his labourers. In addition to these, there are also about 400 licenced merchants who purchase fish and remove by bicyles and who are given one entrance pass each. There are also about 85 fish buying agents who are provided with 10 entry passes each for his use as well as his workers. Besides, a large number of other extra labourers also enter inside the harbour paying the prescribed entrance fee. The number of extra labourers depends mainly on the landings. Apart from these the authorities are collecting prescribed berthing charges for various types of fishing boats which come to the harbour for the disposal of the fish, as well as fixed toll charges for the different types of vehicles coming inside the harbour for transport of fish catches.

All these toll charges, licences fees and berthing charges remained unchanged till 31-12-1981. The rates of these licences and fees were revised recently and the implimentation of the revised rates from 1-1-1982 is understood to have triggered the crisis at the harbour from 1-1-1982. As a protest against the harbour authorities fish landings were boycotted by all the categories of people engaged in the trade. The old rates and the enhanced rates from 1-1-1982 are given in table 1.

Details concerning the agitation

On the morning of 1st January 1982 when the drift gill net boats arrived at the harbour as usual to dispose of the catch, the authorities claimed the enhanced berthing charge of Rs 5/- instead of the old rate of Rs 3/-. The boat crew refused to pay these enhanced rates. The merchants and the agents joined hands and did not participate in the sale of the fishes. Out of the 29 drift net boats berthed, a few that unloaded their catch did not get any reasonable price due to the non-cooperation of the agents and the merchants. So the remaining boats took their catches to the nearby private jetties and sold the fish. None of the boats paid the berthing charges.

In the afternoon of the same day 2 purse seiners and 12 carrier boats were observed at the harbour, with the catch iced and covered with coconut palm (Cudjan) leaves in the boat itself due to lack of agents and merchants for the sale. Their catch consisted of a total of 7.5 tonnes of *Caranx djeddaba*, 13.5 tonnes of Oil sardine (*Sardinella longiceps*), 200 kg of Seer fish (*Scomberomorus commerson*) and 100 kg of black pomfret (*Parastromateus niger*). By about 16.00 hrs all these boats left the harbour with the fish and disposed it at the nearby private jetties at Thoppumpady, Fort Cochin, Vypeen and Murukkumpadam area. A total of 14 purse seiners and 153 carriers as well as several shrimp trawlers that arrived at the harbour also had to take their catches to other areas for selling. A few boats that unloaded their catch at the harbour had to sell their fish at throw away prices.

On 2-1-1982 only drift net boats brought catches to the harbour. But all the 37 of them left the harbour without unloading and disposed the catches at the nearby jetties.

Next day being a Sunday none of the boats operated. On 4.1.82, 35 drift net boats, 24 purse seiners and 127 carrier boats and shrimp trawlers together, after bringing their catches to the harbour left without unloading to nearby areas for the sale of fish.

On 5-1-1982, out of a total of 26 drift net boats berthed at the harbour 9 sold their fish at the harbour without paying any berthing charges. The rest 17 numbers landed at the Amruth Ice and Cold Storage jetty at Thoppumpady after paying Rs 1/- each as landing charges. The agents and the merchants actively

*Prepared by R. Reghu, K. Balachandran and M. Abdul Nizar.

Table 1. *Charges levied by the Harbour authorities at Cochin*

Items	Old rate from Dec. 1978 to 31.12.81	Enhanced rate from 1.1.'82	Revised rate after the agitation
A. *Berthing charges*			
i. Purse seiners	Rs 15/- per day with catch	Rs 25/- per arrival with catch	Rs 25/- per arrival with catch
ii. Trawlers & purse seine carriers	Rs 5/- "	Rs 7.50/- "	Rs 6/- "
iii. Gill net boats	Rs 3/- "	Rs 5/- "	Rs 4/- "
B. *Licence fees*			
i. Merchants who partake in auction in the harbour and remove the fish purchased by all modes of conveyance except by bicycles	Rs 30/- per month	Rs 50/- per month	Rs 50/- per month from March 1982 onwards only
ii. Merchants who purchase fish and remove by bicycle	Rs 10/- per month	Rs 15/- per month	Rs 15/- "
iii. Agents working in the Harbour	Rs 100/- per month	Rs 150/- per month	Rs 150/- "
C. *Toll for entry of vehicles* (from 6.00 AM to 6.00 AM next day)			
i. Hand cart	Rs 1/- per day	Rs 2/- per day	Rs 2/- per day
ii. Auto truck	Rs 1/- "	Rs 3/- "	Rs 2/- "
iii. Cycles with maximum 2 baskets	Rs 0.50 "	Rs 1/- "	Rs 1/- "
iv. Tempo van	Rs 2/- "	Rs 5/- "	Rs 5/- "
v. Lorry	Rs 4/- "	Rs 10/- "	Rs 10/- "
D. *Extra levy for vehicles for space utilised by the articles in connection with the handling, scales etc.*			
i. Hand cart/Auto truck	Nil	Rs 2/- per trip with materials such as creeper, baskets, cudjan leaves etc.	Nil
ii. Tempo vans with materials	Nil	Rs 4/- "	Nil
iii. Lorry with materials	Nil	Rs 5/- "	Nil
iv. Extra levy for the ice taken inside the harbour by any mode	Nil	25 paise per block of 50 kg (subject to a minimum of Rs 1/-)	15 paise per block of 50 kg (no minimum payment of Rs 1/-
v. Entry fee for extra labour	Rs 2/-	Rs 1/-	Rs 1/-
E. *Berthing charges for crafts used for unloading materials*			
i. Boats other than gillnets	Nil	Rs 7.50/- per day	Rs 7.50/- per day
ii. Gill net boats	Nil	Rs 5/- "	Rs 5/- "
iii. Extra charges for space utilisation (for materials landed from the waterside)			
a) Materials like creepers, baskets, cudjan leaves etc unloaded from Trawl net boats	Nil	Rs 5/- per arrival	Rs 5/- per arrival
b) Materials like creepers, baskets, cudjan leaves etc unloaded from gill net boats	Nil	Rs 3/- "	Rs 3/- "
F. *Charges for utilising space for net repairs*			
i. Purse seine nets	Rs 15/- per day	Rs 25/- per day	Rs 25/- per day
ii. Gill nets	Nil	Rs 5/- per day	Rs 5/- per day
iii. Trawl nets	Nil	Rs 5/- per day	Rs 5/- per day
G. *Charges for using bath rooms & latrines*			
i. Bathrooms	20 paise per bath	20 paise per bath	20 paise per bath
ii. Latrines	10 paise per one use	10 paise per one use	10 paise per one use

participated in the selling and purchasing of the catch here.

From 5-1-1982 to 7-1-1982 the purse seine as well as the trawl catches were taken to different places for sale. It is understood that they have selected landing centres right from Alleppey in the South to Narakkal in the North and to Chambakkara in the east in the Vempanad lake area depending on availability of facilities for unloading and transportation of the catch.

Negotiation and restoration of normal activities

The enhanced toll charges and the other rates were intimated to the public by the harbour authorities through a notification in the Kerala Gazette published on 22-12-1981. The representatives of the

various categories of people engaged in the trade met and submitted a memorandum to the Chairman of the Cochin Port Trust who is also the Chairman of the Advisory Committee of the Cochin Fisheries Harbour on 31-12-1981, requesting for a stay in the implementation of the revised rates for sometime in order to enable them to discuss the matter in detail with the Chairman. The Chairman assured the representatives that due consideration would be given to their representation, at the meeting of the Board of Trusties and Advisory Committee.

Following a discussion of the representatives of the trade with the Chairman on 7-1-1982, (the 7th day of the agitation) in which the latter gave the assurance that their protest in the enhancement of the rates would be seriously considered and a positive decision in their favour taken in the next Advisory Committee Meeting, the normal functioning of the Fisheries Harbour was resumed from 8-1-1982. As assured by the Chairman, the Advisory Committee of the Cochin Fisheries Harbour met on 22-1-1982 and after discussions agreed to reduce some of the revised berthing charges for the boats, toll charges of some of the vehicles, the toll charges on ice etc. (vide table I).

First week of February 1982

Cochin Fisheries Harbour constructed at a cost of Rs 4.0 crores, although provided with the facilities for handling, packing and transport of the catch, lacks one of the vital facilities ie. an Ice Plant that could produce required quantities of ice for preserving the catches landed. Inside the Campus there is a small ice plant with a capacity of 25 tonnes per day managed by a private party and started functioning recently.

Lack of sufficient ice to preserve the catch has resulted in dumping large quantities of decayed oil sardine and other fishes on several occasions. On 28-1-1982 for instance, a total of about 1,000 tonnes of big sized oil sardine (180-215 mm) was caught off Cochin and brought to the harbour by the purse seiners and carriers. In addition, indigenous crafts fitted with out board engines were also hired by the purse seiners in the sea to carry the oil sardine catch to nearby centres.

As there was not sufficient ice available in the Fisheries Harbour to preserve the 1,000 tonnes of oil sardine landed there, the merchants were reluctant to purchase the fish. With the result the price came down from the usual rate of Rs 900 - 1,500 to Rs 400 - 500 per tonne. Even at the reduced price the whole catch was not taken. So nearly 25 tonnes of decayed oil sardine were dumped in the backwaters and several tonnes of decayed fish were transported for use as manure.

The ice required at the Fisheries Harbour has to be brought from nearby private Ice Factories in and around Cochin in 50 kg blocks by lorries, push carts and other transports and thus made available inside the harbour for purchase. Initially in 1978 the price of ice inside the harbour was Rs 70/- per tonne which later rose to Rs 100/- per tonne.

Till 31-12-1981, the harbour authorities were not levying any charges for bringing ice inside the harbour. But from 1-1-1982 onwards a levy of 25 paise per ice block of 50 kg subject to a minimum of Rs 1/- was introduced. As a result the ice merchants increased the price of ice from Rs 100/- to Rs 115/- per tonne.

In protest against this increase in the price of ice, the fish merchants started an agitation and struck work from 3-2-1982 demanding a reduction of the price of ice. Their demands also included commissioning of an ice Factory and a freezing plant inside the harbour. The grievance of the fish merchants was that the price of the ice was only Rs 45/- per tonne in the neighbouring places of Cochin.

Due to this strike by the fish merchants all the fishing boats operating from the harbour had to suspend their fishing operations.

The protest and the agitation by the fish merchants continued for 3 days from 3-2-1982 to 5-2-1982. However, normal fishing operations were resumed on 6-2-1982 onwards after the private ice plant owners at Cochin agreed to reduce the price of ice to Rs 95/- per tonne as a result of negotiations by the Sub-Collector of Ernakulam. The levy of 25 paise per ice block of 50 kg was reduced to 15 paise, without any fixation of minimum.

Problems of the purse seine boat crew

There are about 52 purse seine boats operating at Cochin Fisheries Harbour each having a crew of about 30 persons. The crew members of these purse seiners are understood to have started an agitation for getting increased share of their wages. Till recently the crew were given 30% of the amount realised from sale of catch as their share. (ie. 30% of the total price of the fish, after deduction of 5% commission for the auctioner or the agent). From December 1981 the purse seine boat owners are giving to the crew only 30% of the net amount realised (ie. after deducting the days expenses such as diesel, oil, mess expenses for the crew etc. from the total realised amount). The crew wants the original payment of the share of wages restored and are agitating for the same. Negotiations for an amicable settlement of the problem are under way and it is hoped that a settlement in the grievences of the crew will be found

soon, which would very much help in the smooth functioning of the purse seine fishing activity at Cochin. In resolving such problems in the various segments of the fisheries, more concern and involvement of the State Department of Fisheries would be helpful.

ILLEGAL FISHING IN INDIAN WATERS

As reported in September issue of Marine Fisheries Information Service, poaching by foreign vessels in India's Exclusive Economic Zone, particularly in the northern part of the Bay of Bengal, has become a grave problem. Five Thailand trawlers including one mother vessel were captured on 18-11-1981 by Indian coast guard from the sea close to the mouth of the river Ganges, 18 miles south of Sandhead. The crew of these vessels, 107 in number, were arrested and subsequently released on bail. The catch, mostly shrimps, was confiscated and handed over to Apex Co-operative Society of West Bengal.

Operations of Thai trawlers were reported by fishermen from Contai and Balasore coast. The number of trawlers operating in this area during 1981-82 are reported to be 75 to 100 and sometimes they are found to fish even at a distance of 30 km from the shore at depths 40-45 m. These operations close to the shore cause damages to the drift nets operated in these waters by local fishermen. These drift nets, varying in sizes from 3,200 to 4,800 ft long cost Rs. 20,000 to 30,000. From Digha area some of the fishermen have reported loss of their nets due to the operation of these trawlers. Large quantities of dead fish of different varieties floating in the waters in these areas indicate that these boats only keep the shrimp catch and throw away the by-catches, thereby wasting the resources.

The skippers of Indian trawlers operating in this area often complain about the foreign trawlers that they do not abide by international rules, moving in zigzag routes and without navigational lights in the night. Shri G. Mayabhan, skipper of trawler '*Sunita Rani*' reported to his base at Visakhapatnam about citing 40 Thai trawlers operating along the coast between Sandhead and Dhamra river on 2-10-1981. The skipper of another trawler "*Blue Angel*" Shri C. M. A. Rashid reported to Visakhapatnam about seeing 30-40 Thai trawlers fishing at 40-45 m depth region in between Sandhead and Paradeep.

These foreign trawlers are mostly 25 m to 50 m in length and equipped with powerful radars, which help detection of Indian coast guard vessels at very long distance and enable escape to waters of neighbouring countries or deeper areas. With the limited number of patrol vessels and equipments at its disposal the coast guard is trying its best to cope up with the situation and the capture of these 5 vessels is an indication of the surveillance and vigilance kept by them.

Reported by S. S. Dan.

CYCLONE HAVOC ALONG SAURASHTRA COAST

A severe cyclone with gales of 100-120 km lashed the Saurashtra coast of Gujarat on 1/11/81 causing heavy damages. Cyclone warning centre in Bombay precisely predicted the course and intensity of the cyclone and warned the Gujarat Government. The State Government alerted the public and the administrative machinery was geared up to meet the eventuality. The cyclone crossed the land between Veraval and Porbandar in the early hours of 2/11/81. Throughout 1/11/81 heavy gales were experienced in these localities. In spite of all the precautionery measures the cyclone inflicted heavy damage to the region. The total loss was estimated between 50-70 crores of rupees. About 14 people were killed at different places either due to drowning or house collapses. Junagadh district was the worst affected. Although preliminary estimates of loss of life, boats, crops and other properties were staggering, it turned out to be not so damaging when full details were available.

The harbour towns of Veraval, Mangrol and

Table 1. *The damages at different fishing villages of Gujarat due to cyclone on 1/11/1981*

Fishing village	Total loss of boats Nos.	Total loss of boats in Rs.	Damage to boats Nos.	Damage to boats in Rs.	Loss of nets Nos.	Loss of nets in Rs.	Damage to houses etc., in Rs.	Total damage in Rs.
Rajpara	–	–	10	2,000	–	–	1,50,000	1,52,000
Madhwad	1	15,000	8	3,900	–	–	1,00,000	1,18,900
Mul-Dwarka	1	20,000	18	66,400	1,573	2,44,150	1,00,000	4,30,550
Dhamlej	5	85,000	6	24,000	95	17,250	–	1,26,250
Sutrapada	1	20,000	16	29,800	317	51,075	50,000	1,50,875
Hirakot	1	8,000	3	7,000	2,293	5,24,300	20,000	5,59,300
Vadodara Bara	–	–	–	–	60	9,000	–	9,000
Jaleshwar	2	40,000	4	11,000	2,136	5,75,000	1,00,000	7,26,000
Mangrol	1	2,50,000	60	1,86,600	–	–	2,50,000	6,86,600
Shil	–	–	–	–	219	44,600	50,000	94,600
Madhavpur	–	–	2	22,000	1,367	4,10,100	–	4,32,100
Veraval	–	–	83	3,38,400	53	21,600	15,000	3,75,000
Porbandar	–	–	124	1,89,850	463	3,07,800	2,02,654	6,99,304
Total	12	4,38,000	334	8,80,950	8,576	22,04,875	10,37,654	45,61,479

Porbandar suffered maximum. Electricity, telecommunication, water supply were disrupted completely and could be restored fully after a week only. The damage to crops like ground nut, cotton, Bajara was very extensive. A number of houses collapsed or were damaged in the coastal towns and villages, particularly fishing villages.

Loss to the fisheries sector of Junagadh district is given in table 1, from which it could be observed that the maximum number of boats were damaged at Veraval and Porbandar. But for the alertness of coast guard the damage would have been much more. Expecting the seriousness of the situation the coast guard guided all the boats moored in the open harbour into the sheltered pockets of the harbour. At Veraval 83 boats, mostly mechanised, were damaged and 53 nets were lost. The loss here to the fishing industry was estimated at Rs. 3.75 lakhs. Apart from this there was an extensive damage to the fishing harbour under construction with world bank aid. Due to high waves the breakwater wall under construction was wiped out about 80 m length on the eastern and western side of the fisheries harbour. The damage was estimated to Rs. 25 lakhs. Barges of the port department (5 in number) sank in the harbour and a dredger was damaged costing the port department an estimated 12.6 lakhs of rupees to float and then repair. About 8 people died in a house collapse and one cargo vessel ran aground in the harbour and another sank off shore. The crew of the vessel swam ashore except one, whose body was later washed ashore.

At Mangrol 60 boats were damaged and 1 trawler was missing. Loss to boats and nets was estimated at Rs. 6.86 lakhs. Damage to fishing harbour was also extensive and the loss was estimated at Rs. 25 lakhs. There was an extensive damage of houses at this place.

At Porbandar the maximum of 124 boats were damaged and 463 nets lost with an estimated loss of Rs. 7 lakhs. Apart from this the all-weather port at Porbandar suffered a damage coasting Rs. 10 lakhs.

From Rupan 348 boats left for fishing on 1/11/81 and drifted to different ports. Navy was asked to search for these boats. 6 Naval ships combed the Arabian sea and found that most of the vessels reached different ports along the coast. Still 3 fishing vessels with a total crew of 20 are reported missing.

The fishing industry of Junagadh district on the whole is estimated to have suffered a damage of about Rs. 45.6 lakhs. Measures are being taken by the State Government for the relief and rehabilitation of those affected, particularly the fishermen who lost their property.

Reported by G. Sudhakara Rao.

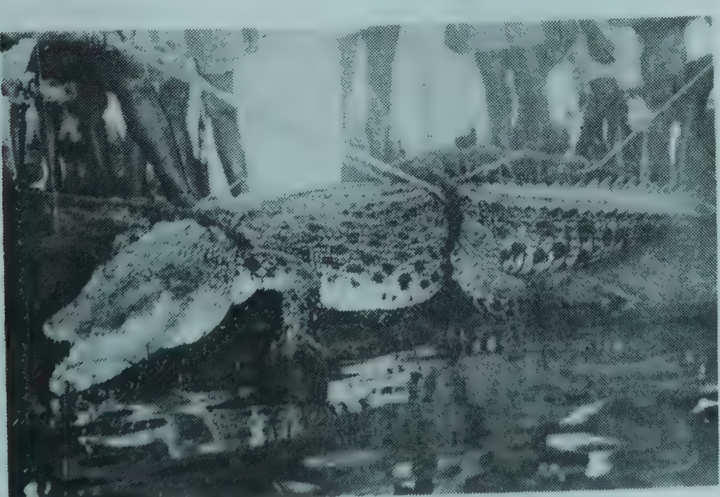
NEWS-INDIA AND OVERSEAS

Tropical Fisheries Consultancy Services

A multidisciplinary consultancy service in fisheries, entitled Tropical Fisheries Consultancy (TFC) Services has been started with headquarters at Delhi. The specializations are marine small scale and artisanal fisheries, fishing harbours and infrastructure development, fishing craft and gear, mechanised and deep sea fisheries, fish processing and product development, marketing, aquaculture, aquaculture engineering and inland capture fisheries. Intended to serve private enterprises, corporate bodies, including co-operatives, governmental agencies, international agencies, aid giving countries, aid receiving countries, financial institutions and research and development agencies, the services offered are socio-economic surveys, preinvestment surveys, operational projects, turn-key jobs, integrated area development projects, joint ventures, charters, designing, procurement and supply of equipment, training of personnel counselling, documentation, costing, finance and financial analysis, management and custom services. Dr. T. A. Mammen formerly Joint Commissioner (Fisheries), Government of India is the Managing Director and Mr. M. Devidas Menon, Mr. P. P. Dinglasan, Dr. G. P. Dubey, Miss Aye Aye Myaing, Mr. Fred H. Meyer, Mr. George P. Varghese and Dr. S. V. Gokhale consultants. For further particulars please contact Tropical Fisheries Consultancy Services, C12, Vivek Vihar, Delhi 110 032, India.

A rare marine crocodile landed at Thirumalairayanpattinam

On 3rd March 1982 a rare crocodile was caught in a gill net "thrukkai valai" operated by two fishermen Vairakkannu and Kalaivanan about 5 km off the coast of Thirumalairayanpattinam, nearly 330 km south of Madras and 16 km north of Nagapatnam. Fifty fishermen with two mechanised boats helped them to bring the giant reptile to the shore. The animal was tied up with ropes in an irrigation canal.



The crocodile (Photo) is dark yellow in colour with black patches all over the body and measured 2.62 m in length. It was identified as the coast crocodile, *Crocodilus porosus* Schneider, one of the rare among the 20 species recorded from India. It was reported earlier from the east coast of India, ascending rivers atleast up to tideway. It is the largest of the crocodiles and a notorious man-eater.

The reptile was transported to the snake farm near Kovalam in Madras in living condition and is being reared there. According to the farm manager Mr. Allan the skin of this species is very thin and soft and therefore highly valuable.

Reported by K. S. Krishnan

Shrimp roe processed

Shrimp roe is a luxury product fetching very high prices. An Icelandic company manufacturing fish processing equipment, Traust Ltd, has developed a shrimp gonad extraction plant for installation either on board ship or at the freezing plant.

The method of processing is an adaptation of their capelin roe extraction plant and at the moment at the prototype stage. Shrimp and water is pumped into a squeezer where the gonad is pressed out. A straining conveyer separates the roe-containing liquid from the shrimp which are then processed. The roe is then separated from the liquid, washed and weighed into boxes and frozen or salted.

World Fishing 30 (4): April 1981

Krill peeling machine prototype

Laitram Corporation has developed a prototype machine for peeling krill at sea. The machine is designed to peel 1000 lbs per hour of krill input with an output of 200 lbs per hour of peeled tail meat. The prototype weighs approximately 1 tonne but the final machine will weigh considerably less. The machine is being experimented in Antarctica and if successful Laitram hope to have machines ready for sale by November 1982. For onshore peeling a simplified version can be used. But shore-based peeling of fresh krill seems doubtful due to the four hour time limit in which the krill meat goes bad after capture.

World Fishing 30 (4): April 1981

Compiled and prepared by M. J. George and G. Subbaraju.
Published by Dr. M. J. George, Senior Scientist on behalf of the Director, Central Marine Fisheries Research Institute, Cochin-682 018 and printed at PAICO, Cochin 31

MARINE FISHERIES INFORMATION SERVICE

Technical and Extension Series

No. 37

APRIL 1982

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE

COCHIN, INDIA

INDIAN COUNCIL OF AGRICULTURAL RESEARCH

THE MARINE FISHERIES INFORMATION SERVICE: Technical and Extension Series envisages the rapid dissemination of information on marine and brackish water fishery resources and allied data available with the Fishery Data Centre and the Research Divisions of the Institute, results of proven researches for transfer of technology to the fish farmers and industry and of other relevant information needed for Research and Development efforts in the marine fisheries sector.

Abbreviation - *Mar. Fish. Infor. Serv. T & E Ser., No. 37*: 1982.

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Cover photo: Purse seine operation at Mangalore

THE PURSE SEINE FISHERY OF MANGALORE (KARNATAKA)*

Introduction

Karnataka State, with about 300 km of coastal line extending from Majali in the north to Talapady in the south contributes about 8.3% to the total marine fishery catch of the country. The average annual catch of this state for the five-year period 1970- 74 amounted to 96,217 tonnes which increased to 0.12 million t during the period of next five years (1975-79). The increase during the latter years was mainly attributed to the augmented fleet strength of trawlers and to the introduction of purse seiners from 1975 onwards. Undoubtedly, the rapid increase in the strength of purse seine fleet gave the necessary fillip to the marine fisheries, especially for the exploitation of hitherto underexploited resources like anchovies, horse-mackerel, cat fish etc., in addition to the other traditional pelagic fisheries viz., oil sardine and mackerel. The introduction of purse seine, though initially resented by the artisanal fishermen, neverthless, was rather smooth. As a result of this, once active landing centres of Dakshina Kannada for the indigenous gear have to bear the brunt of the change over in the age old traditional fishing method and wears the deserted look within a short time.

The famous shore-seine, *rampani* has become ineffective and obsolete, of late. To the rescue of fishermen who were wholly dependent on this gear, the schedule banks have come forward to extend credit facilities both on individual and co-operative basis for acquiring purse seine units.

The activities of purse seiners are restricted to Mangalore, Malpe, and Gangoli in Dakshina Kannada mainly due to the availability of some infrastructural facilities viz., berthing, transport of fish, ice plants, cold storages, oil, fresh water etc. An appraisal of the purse seine fishery at Mangalore has been made in this account based on the fish landings from 1979 to 1981.

Operation

The purse-seiners at Mangalore are of wooden hulls, by and large are of 43′ in length, and a few of 38′ also. A few of them have fibre-glass hulls.

The net is of synthetic fibre and usually knotless. This is about 600 m in length with a height of 50 m, with a mesh size of 14-18 mm. About 40 brass rings are used for pursing the net.

Normally the purse seiners set out for fishing by the break of dawn. The strength of crew of a purse seiner varies from 20 to 25. This excludes crew (2-3) of a carrier boat which each purse seine unit employs for 2-3 months during the peak fishing season to cope up with the transport of fish from the fishing ground to the landing place. Incidentally, this peak period happens to be a lean one for trawlers which are then converted as carrier boats. Nearly 100 purse seiners operate from Mangalore.

Time taken to complete a haul varies from 1-3 hours depending upon the catch. As there is a severe competition amongst fishermen, at least 1-2 hauls are made to send fish catch in the morning by carrier boats as quickly as possible for better financial returns. On an average 3-4 hauls are made daily.

Depending upon the availability of fish, the boats return home usually by 6 pm, by the time the carrier boats having made 2-3 trips to unload the catch. It is not uncommon to see the fishing activities extending upto 10 pm in the Mangalore waters.

Many a time handling of large catches, particularly of cat fish, poses a problem. As a custom, purse seiners operating in the vicinity of a boat which has pursed such a catch, come to their aid. The cat fish, though fetches better returns, neverthless, damage the net to a great extent.

The operational area of purse seiners of Mangalore extends in the region between Kaup in the north (45 km) and Kasargod in the south (40 km), but are mostly active in the southern area because of a severe competition offered by the purse seine units operating from Malpe.

During September-January these units restrict their activities around 20 m deep waters since this period coincides with the abundance of shoaling fishes. However, from February onwards with thinning of shoals extend their activities beyond 30-40 m depth.

Fishermen are forbidden by the local authorities to go out for fishing from 1st June to 30th September since this period happens to be the active spawning period for commercially impor-

*Prepared by M. H. Dhulkhed, C. Muthiah, G. Syda Rao and N. S. Radhakrishnan.

tant fishes like oil sardine, mackerel, etc. On a few occasions, infringement of this restriction was made by some units and considerable quantities of oil sardine and mackerel in spawning condition were caught causing much concern to the conservationists of marine resources.

Fishery resources

By and large, oil sardine and mackerel constitute the major catches of purse seine (Photographs). The new resources exploited fairly on a large scale were cat fishes, anchovies and carangids (Fig. 1).

The estimated catch of important fishes for the years are given in Table 1. It may be seen that the catch in 1979 amounted to 27,197 t, showed a marginal increase in 1980 and the catches in 1981 increased by 35.6% over 1979. This was mainly due to the increase in effort and catch of oil sardine.

It is seen from Fig. 2, that during the post-monsoon period, expending about 55% of the annual effort, 80% of the annual catch is realised, in contrast to the premonsoon period (January -June) when about 45% of the effort was put to realise only about 20% of the annual catch.

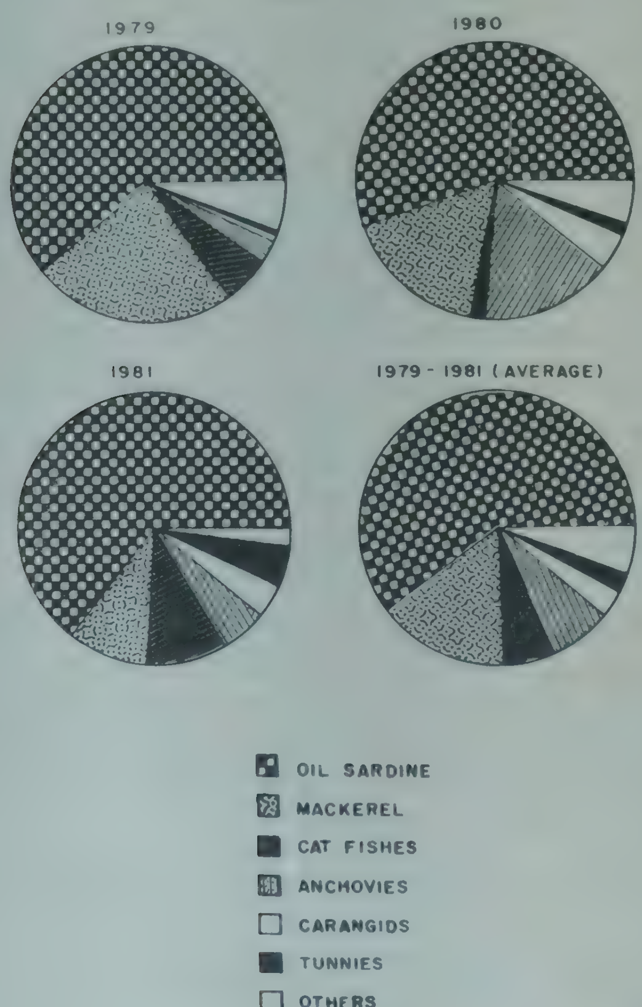


Fig. 1. Catch Composition of fish landed by purse seiners at Mangalore.

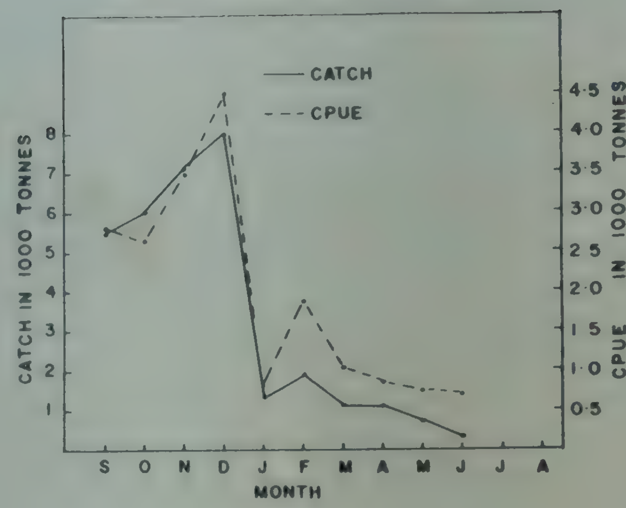


Fig. 2. Average catch and catch per unit effort in tonnes of purse seiners at Mangalore.

Oil sardine

The oil sardine formed the major pelagic fish component of purse seine landings. It is seen from Table 1 that the catch was around 16,000 t in 1979 as well as in 1980 with more or less equal effort expended in both the years, whereas it rose to 27,000 t in 1981, of course, with an increase in effort also. Generally, October-December forms the most productive quarter, with highest catch rate being recorded in December. About 79% of the oil sardine landings were made, during the post-monsoon season. Oil sardine constituted 61%, 55% and 64% of the total catch in 1979, 1980 and 1981 respectively. Since there are no facilities for canning, most of the catch, that could not be marketed in fresh condition, was utilized for oil extraction and manure.

Mackerel

This resource ranks second next to oil sardine in respect of yield. The success or failure of the purse seine fishery in this part of the coast largely depends upon the success or failure of this fishery. The average annual catch of mackerel in Karnataka for the five-year period 1975- 79 was 30,385 t. The Mangalore purse-seines contributed 16.7% to the total mackerel catch of the state in 1979.

During 1979, the catch of this fish amounted to 6,691 t, however, showed a decline of 27% in 1980. The 1981 season was no better since the catch decreased to as low as 3,960 t. It is interesting to note that the beginning of the fishing season, particularly September month recorded better catches of mackerel.

Table 1. *Fish landings of Purse-seines at Bunder, Mangalore (in tonnes)* 1979–81.

Month	Oil sardine	Mackerel	Catfishes	Anchovies	Carangids	Tunnies	Other clupeoids	Leiognathus	Prawns	Others	Total	C.p.u.e.*
1979												
January	487	375	—	88	—	—	113	—	—	30	1,093	0.80
February	1,211	310	—	7	—	—	37	—	—	—	1,565	1.53
March	1,058	433	3	81	1	—	60	—	—	—	1,636	1.55
April	1,319	298	—	2	6	—	90	7	—	—	1,722	1.61
May	51	161	—	3	27	7	164	22	—	—	435	0.73
June	353	399	—	—	5	32	6	6	—	—	801	2.47
July					No fishing							
August					" "							
September	766	2,845	143	—	25	3	85	95	—	84	4,046	2.16
October	3,855	1,249	115	157	188	7	27	216	—	68	5,882	2.45
November	4,621	621	258	333	—	—	81	—	—	—	5,914	2.92
December	2,876	—	1,023	60	6	63	45	—	—	30	4,103	3.08
Total	16,597	6,691	1,542	731	258	112	708	346	—	212	27,197	2.08
1980												
January	1,285	124	20	14	6	59	18	2	11	16	1,555	1.21
February	2,646	61	23	38	1	5	57	—	—	—	2,831	3.15
March	376	7	74	40	17	239	36	—	—	—	789	1.55
April	15	6	—	—	77	6	384	83	—	—	571	0.80
May	673	—	—	—	—	77	201	—	—	—	951	1.28
June					No fishing							
July					" "							
August					" "							
September	3,583	3,123	50	2	98	27	83	16	395	96	7,473	3.19
October	779	861	193	2,255	110	—	58	96	—	60	4,412	1.84
November	2,857	49	41	2,071	878	10	21	18	—	20	5,965	2.69
December	4,021	646	—	151	8	—	7	—	—	—	4,833	2.60
Total	16,235	4,877	401	4,571	1,195	423	865	215	406	192	29,380	2.27
1981												
January	1,133	260	12	3	18	26	—	—	—	3	1,455	0.65
February	1,237	14	—	12	9	3	—	—	4	10	1,289	1.22
March	223	377	159	50	9	163	—	2	—	4	987	0.58
April	588	132	69	26	70	45	7	5	28	55	1,025	0.49
May	17	4	—	—	1	—	—	—	—	17	39	0.03
June	55	201	—	—	3	—	—	—	—	—	259	0.87
July					No fishing							
August					" "							
September	1,621	1,700	—	745	550	177	—	—	—	—	4,793	3.00
October	2,244	1,130	2,551	99	655	1,142	—	—	—	6	7,827	3.88
November	7,770	142	—	950	297	368	—	—	—	—	9,527	5.18
December	12,327	—	1,199	437	23	37	125	—	—	920	15,068	6.50
Total	27,215	3,960	3,990	2,322	1,635	1,961	132	7	32	1,015	42,269	2.53

*C.p.u.e. = Catch per unit effort

Apart from local consumption in fresh condition, when the landings are heavy they are iced in trucks and sent to Bombay, Bangalore and interior places of Karnataka and Kerala.

Cat fishes

With the advent of purse-seines, this resource which remained underexploited by the indigenous gear, has assumed a significant importance. The dominant species which constitute the fishery are *Arius dussumieri, A. thalassinus, A. serratus* and *A. tenuispinis*. The average annual cat fish catch in Karnataka for the period 1975–79 was 5,083 t, forming 4.5% of the total fish catch. However, the purse seines at Mangalore alone contributed 15.5% to the total cat fish catch in the state during 1979. The estimated catch of this species during 1979 amounted to 1,542 t, which showed a decrease of 74% in the subsequent year. Nevertheless, the catches in 1981 was 3,990 t registering an increase of 159% over 1979. Incidentally during all the three years of observation, October was the month in which heavy landings were made.

It may be pointed out here that this resource

which holds promise for future, is indiscriminately exploited from the nursery grounds as was witnessed from the large scale fishing of *A. tenuispinis* with eggs in various stages of development in their mouth during September and October 1979 (*Mar. Fish. Infor. Serv. T & E Ser.*, No. 24, 1-9, 1980) causing incalculable loss, which could be gauged from the destruction of eggs estimated at weighing as much as 16 t. Similar indiscriminate fishing was repeated in 1981 also. It is feared that resorting to such destructive fishing may cause deleterious effect on this resource in the coming years.

As there is very limited market for consumption in fresh condition locally, cat fishes are sent in iced as well as sun-dried form to interior parts of Karnataka and also to Kerala and Tamil Nadu.

Anchovies

This resource, though detected earlier, remained elusive so far to the indigenous gears and has now come within the reach of purse seines. Locally known as Kollataru , the anchovies or white baits, represented by *Stolephorus devisi, S. buccaneeri* and *S. bataviensis* rank third in the catches. The average annual catch of this resource in the state for the five-year period 1975-79 was 480 t constituting a mere 0.4% in the total catch. However, this picture changed for better from 1979 onwards. During 1979 the seiners at Mangalore landed 731 t. In 1980 the catch reached an incredible figure of 4,571 t. On the contrary the catches in 1981 almost dropped by 50%.

Anchovies are consumed in dried condition. Huge catches of anchovies have generated employment opportunities among the village folk in sun drying process.

Tuna

This resources which remained so far beyond the reach of the indigenous gear, has come now within the operational ambit of purse seiners. The little tunny *Euthynnus affinis*, the frigate tuna, *Auxis thazard*, and the bullet tuna, *A. rochei* are occasionally caught in considerable numbers, particularly in October. The catch of tunas at Mangalore in 1979 which was just 112 t forming 0.4% of the total catch showed a four-fold increase (423 t) in 1980 and reached a spectacular figure of 1,961 t in 1981. This clearly indicates the vast potential of this resource in our waters, which could be exploited for meeting the demands of our country.

Generally tunas are not relished by the local people. *E. affinis* and *A. thazard* are packed in ice and are sent particularly to Kerala where there is great demand for these fishes. Since *A. rochei* gets spoiled even before reaching the landing place they are utilized for making fish manure.

Carangids

This group is represented by the horse-mackerel, *Megalaspis cordyla* and also by *Caranx kalla* and *Decapterus* spp. More often the former species in small schools are caught with tuna shoals whereas the latter species are hauled up along with silver bellies, anchovies etc. The average catch of these species for 1979-81 amounted to 1,029 t, forming 3.1% of the total catch. October -December quarter appears to be more productive when about 70.2% of the catches were landed.

As there is no local market, particularly *M. cordyla*, they are sent to Tamil Nadu in iced condition from where they could fetch better financial returns.

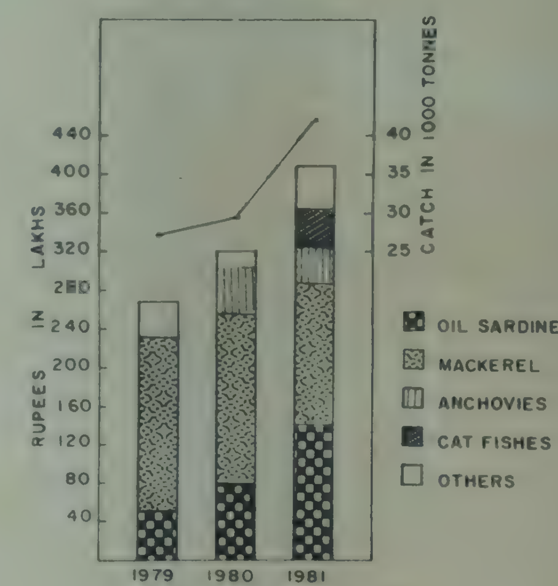
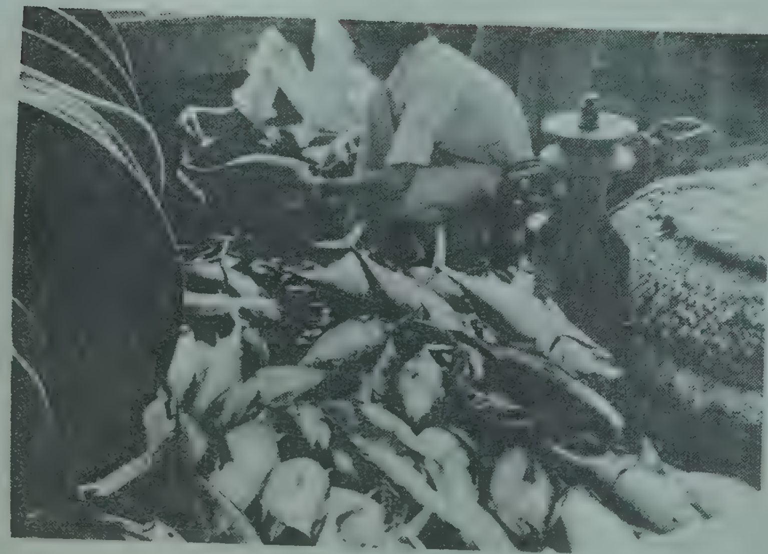


Fig. 3. Value of major groups of fishes and total fish catch landed by purse seiners at Mangalore.

Silver bellies

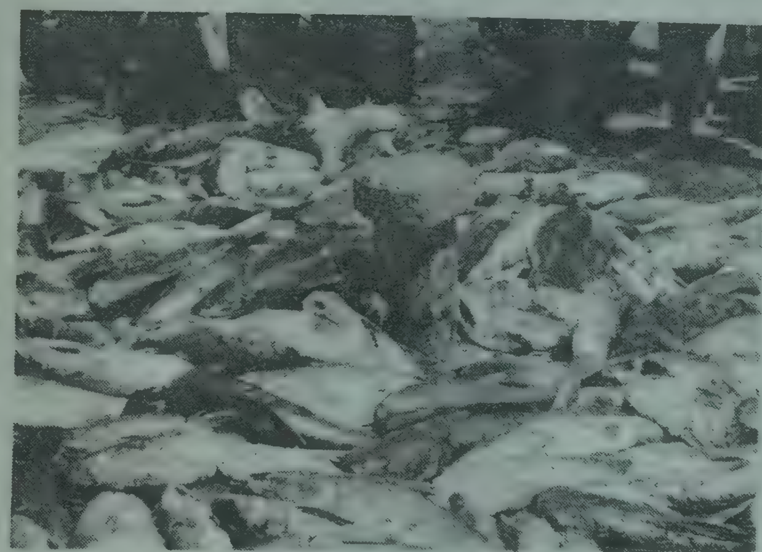
Leiognathus splendens, L. bindus and *Secutor insidiator* form incidental catches. The average annual landings for 1979-81 amounted to 190 t forming 0.6% of the purse seine catch. In 1979, the catch was as high as 346 t, however, dropping to 215 t in 1980 and in the subsequent year as low as 7 t. October appears to be the peak period when more than half (55%) of the annual catches were realised. Silver bellies in fresh condition do not find ready market and as such the catches are invariably used for sun-drying.

1. Oil sardine catch



4. Little tunny *Euthynnus affinis* and other catches

2. Carrier boat filled with mackerel



5. Cat fish catch at the landing centre

3. Carrier boat with frigate tuna, *Auxis thazard*

6. Black pomfret *Parastromateus niger*

Other clupeoids

This group comprises *Sardinella albella*, *S. fimbriata* and *S. gibbosa* and also *Kowala coval*, *Thryssa* spp. and the gizzard shad *Anadontostoma chacuŋda*. Their estimated catch in 1979 was 708 t. Landings in 1980 registered an increase of 18% over the previous year and witnessed a fall in the subsequent year. However, the average catch for 1979–81 was 570 t, contributing 2.3% to the purse seine catch. April-May appears to be the most productive period for this resource. Considerable portion of these catches are channelled for sun-drying.

Prawns

Prawns form one of the incidental catches of purse-seines particularly soon after the commencement of the fishing season in September. The species represented were *Metapenaeus dobsoni*, *Parapenaeopsis stylifera*, *M. monoceros*, *M. affinis* and *Penaeus indicus* in the order of abundance. During September 1980 their catch amounted to 406 t, but, fell precipitously to a mere 32 t during the next year.

Pomfrets

Occasionally, the black pomfret *Parastromateus niger* was landed during 1979 amounting to 36 t whereas in the subsequent two years their catches remained rather insignificant.

Miscellaneous fishes

This group consists of fishes which are incidentally caught when the net is paid out for shoaling species. Common species are the Sciaenid (*Otolithus ruber*), *Dussumieria* sp. *Belone*, *Chorinemus* sp. *Therapon* sp., sharks, rays and cephalopods. The last quarter appears to register better catches of miscellaneous fishes. The average annual catch for the three year period was 544 t, forming 1.6% of the purse seine catch.

7. Cat fish eggs being disposed

Economics

Based on the auction rates prevalent at the landing centre, the total value of fish landed works out to an average of Rs 3.48 crores an year, ranging from Rs 2.7 to 4.1 crores during the 3 years 1979 to 1981. The average return per boat per operating day is estimated at Rs 2,440. Mackerel fetched the highest value, the annual average for the years under consideration being Rs 1.7 crores. This formed about 48% of the annual total income. Cat fishes earned Rs 1.63 million ~~crores~~ in 1979. An all time record earnings of Rs 44.6 lakhs by anchovies was recorded in 1980 as against 7.0 and 38.6 lakhs realised in 1979 and 1981 respectively. The sales proceeds of carangids varied from Rs 1.8 to 1.5 lakhs. The earning of tuna showed a gradual increase from Rs 1.6 lakhs in 1979 to 16.3 lakhs in 1981. The year 1980 was most productive for prawns when their sales touched Rs 28.4 lakhs as compared to just Rs 3 lakhs in the previous year.

8. Truck load of cat fish for transportation

As mentioned earlier, September–November forms a lean period for trawlers and as such they are used as carrier boats. They are hired on contract basis either daily or monthly. In the former case it is about Rs 300/- excluding food and fuel, and in the latter Rs 6,000 per month.

Earnings of crew

The expenditure on the requirement of daily food of the crew is met from the common fund of a purse seine unit. As yet there is no practice of engaging crew members on fixed wages either

daily or monthly basis. However, as a sort of incentive to the crew, a system has been evolved wherein 25% of the day's income would be equally shared by all. During the season, a fisherman earns approximately Rs 4,000 to 9,000.

As most boats are financed by banks, they have to repay the capital as well as interest accrued thereon which works out about Rs 12,000 per month, irrespective of catch or monsoon when the boats are idle.

An analysis of the annual income and expenditure based on the average catch per boat is given below:

1.	Annual return based on average catch per boat	Rs 5,61,200
2.	Expenditure	
	a) Food @ Rs 150 × 230 days	Rs 34,500
	b) Diesel 230 days × 200 litres	Rs 1,48,120
	c) Wages - 25% of annual income	Rs 1,40,300
	d) Carrier boat hiring charges	Rs 30,000
	e) Repayment of loan	Rs 1,44,000
	f) Incidental expenditure (Repairs, spare parts etc.)	Rs 10,000
	Total	Rs 5,06,920

Thus, the minimum amount that a purse seine unit has to earn works out to about Rs 5 lakhs per year as the break-even point.

General remarks

In view of the increasing operations of purse seiners and consequent additional exploitation of the various resources from limited areas, a close monitoring the situation is very essential in order to manage the fishery properly and attain stability of production and economic returns. In this connection one of the important points for consideration is avoiding heavy pressure on critical stages such as juveniles, spawning stocks etc. of some of the resources like oil sardines, mackerels, horse mackerel and cat fishes. More often it is noticed that indiscriminate fishing using the purse seines results in wasteful utilisation of the resources and in some cases even destruction of future resources. The particular method of fishery being in the initial stages it would be advisable that the authorities concerned view the matters relating to the purse seine fishery with the proper management perspective.

DRIFT GILL NET FISHERY OF THE DAKSHINA KANNADA COAST*

Introduction

With the advent of purse seine in 1975 in the Dakshina Kannada (Karnataka) the indigeneous gears particularly *rampani*, *pattabale* and *chalabale* used for shoaling fishes have almost become non functional. However, the drift gill net (*odubale*), which is employed for fishing bigger fishes, of late have assumed greater importance because of its economic viability. In fact in recent years a trend is set for fixing out-board and inboard engines to the existing canoes for harvesting fishes by employing gill nets. Perhaps this would be the forerunner for the development to take place particularly in the Dakshina Kannada and other areas. The drift net catches from Dakshina Kannada constituted about 3% of marine pelagic catches of Karnataka during 1979.

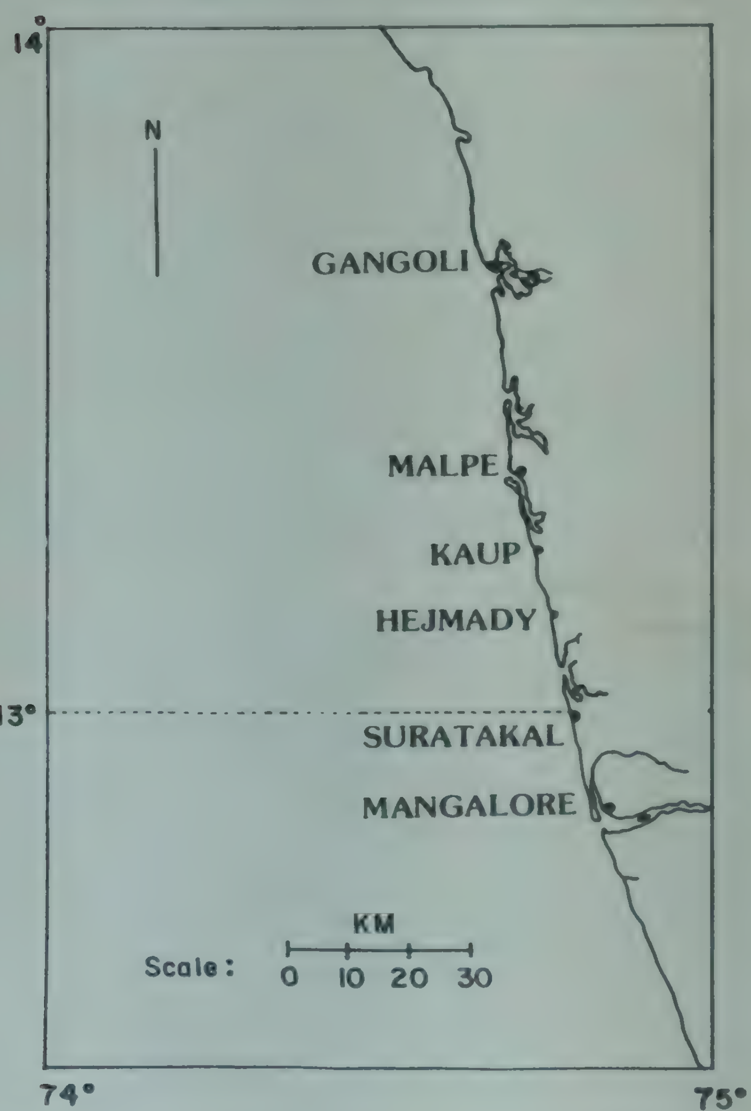


Fig. 1. Map showing drift gill net landing centres in South Kanara.

However, the interesting fact is that once the Dakshina Kannada fishermen could boast of their *odubale* catches. But with the gradual augmentation of trawler and purse seine fleets the local fishermen of this area no longer pursue fishing with this gear. With the result in recent years the fishermen of Kanyakumari and Vizhinjam (Trivandrum) area have made inroads to this region gradually by employing this gear off Dakshina Kannada area. Usually their arrivals commence in the Mangalore area (Mangalore, Suratkal, Hejmadi, Kaupu, Malpe and Gangoli) (Fig. 1) with the close of the south west monsoon. These fishermen, who are experts and very hardy, extend their fishing activities till March/April. The strength of these immigrant fishermen varies from 1,200 to 1,300.

Craft and gear

Usually they hire, on contractual basis, the dug-out canoes (Thoni or Vallum) of 5-6 m length along with the drift gill nets from local fishermen. Besides, they also bring along with them a good number of mechanised vessels of 9.7 m length which afford them greater mobility in quest of better catches.

Generally the fishermen use a dull pink coloured nylon net with mesh size varying from 65 to 135 mm. The length of the net varies from 450 m to 700 m and height 6 to 7 m. However, the mechanised boats employ comparatively longer nets. The fishing operations are confined to 20-60 m depth zone. The concentration of gill nets are more at Kaup than at other centres probably because of better market demand and other facilities. At the close of the season these fishermen return the canoes to the local owners and shift their mechanised boats back to Kanyakumari-Vizhinjam. However, a few enterprising fishermen have permanently brought in their own canoes.

Fishery

Though the fishery is supported by several species the important groups among them are seer fish, elasmobranchs (especially sharks), cat fishes, tunas and bill fishes, mackerel and pomfrets (Fig. 2). Not uncommon are *Chirocentrus*

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*Prepared by C. Muthiah

spp., black king-fish (*Rachycentron canadus*) and carangids.

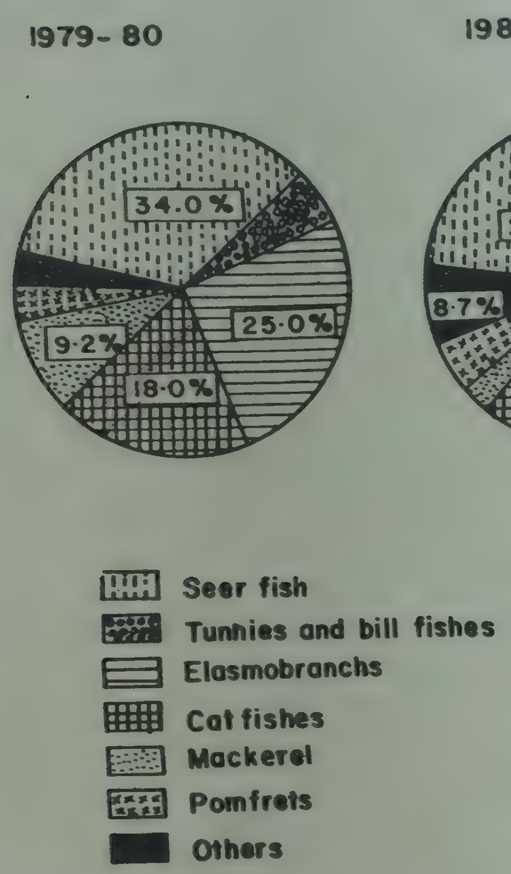


Fig. 2. Catch composition of fish landed by drift gill nets in South Kanara during 1979-80 and 1980-81.

The estimated monthly fish landings for the years 1979-80 and 1980-81 are given in Table 1 and the effort in Fig. 3. It is seen from the table that in the former year the catch amounted to about 2,072 tonnes, showing an increase of 38% during the next year. To certain extent it could be attributed to the extended fishing season by a month. However, the annual catch per unit effort of 90.4 kg in 1979-80 decreased to 80.4 kg in the next year (Fig. 4). The data presented on the Catch Per Unit effort (Fig. 4) and on the species composition (Table 2) of the mechanised and non-mechanised drift gill net units for the period of study show that there is little difference in the catch rates as well as in the relative abundance of different species in the catches by these two types of units.

Catch composition

Seer fish

The catches comprised of king seer, *Scomberomorus commerson*, spotted seer *S. guttatus* and streaked seer *S. lineolatus*. The first two species occurred in all months whereas the last one occurred in few numbers during December - April. *S. commerson* dominated the catches usually from September to December, of which the earlier months being more productive. This species alone formed about 69% of seer fish catches in both years whereas its contribution to the total

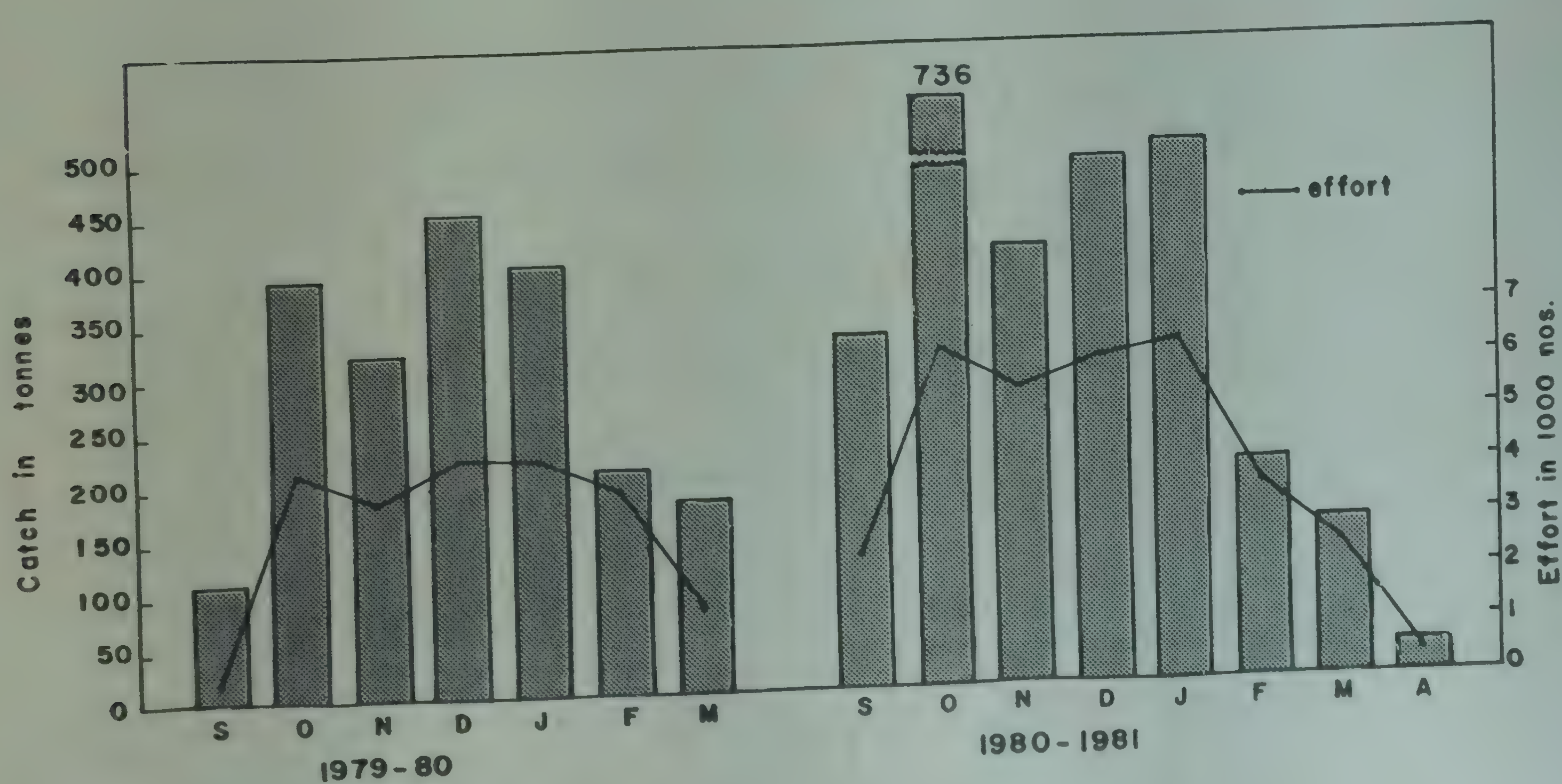


Fig. 3. Month-wise total catch and effort expended during 1979-80 and 1980-81.

Table 1. *Estimated month-wise fish landings (in tonnes) by drift gill nets in Dakshina Kannada during 1979-80 & 1980-81.*

	Species	September		October		November		December		January		February		March		April		Total		Grand
		1979-80	80-81	79-80	80-81	79-80	80-81	79-80	80-81	79-80	80-81	79-80	80-81	79-80	80-81	79-80	80-81	79-80	80-81	Total
1.	Seer fish	9.8	90.0	71.3	327.4	207.1	140.0	174.0	148.7	143.8	126.7	55.9	11.5	41.7	6.7		4.5	703.6	855.5	1,559.1
2.	Tunnies	24.1	54.5	20.6	32.1	20.7	1.1	16.2	10.1	6.8	-	0.3	0.1	-	-		-	88.7	97.9	186.6
3.	Bill fish	-	10.0	4.5	6.4	16.3	18.0	4.9	1.6	2.3	-	-	-	-	0.5		0.1	28.0	36.6	64.6
4.	Elasmobranchs	29.3	97.8	88.7	160.1	28.2	109.1	183.6	65.6	67.8	126.9	47.7	127.5	74.1	107.9		7.2	519.4	802.1	1,321.5
5.	Cat fishes	24.4	58.6	149.7	96.5	25.1	52.4	26.9	129.7	74.8	188.8	36.0	39.9	41.3	18.1	-	4.9	378.2	588.9	967.1
6.	Pomfrets	-	4.9	48.6	41.0	4.4	29.6	5.2	42.8	7.8	13.0	4.0	12.7	0.7	3.4		0.3	70.7	147.7	218.4
7.	Mackerel	25.0	0.4	4.5	7.8	11.7	0.7	18.3	42.8	65.5	13.9	45.6	0.1	19.5	5.4		11.8	190.1	82.9	273.0
8.	Carangids	-	2.8	-	11.2	-	10.2	4.1	4.1	-	0.9	0.7	0.4	-	0.3		-	4.8	29.9	34.7
9.	Chorinemus	-	0.4	-	8.9	-	4.1	0.3	1.2	20.7	5.0	-	-	-	-		0.1	21.0	19.7	40.7
10.	Wolf herring	-	3.9	-	2.9	-	28.7	7.4	31.4	2.1	18.3	2.7	1.4	0.1	0.7		0.1	12.3	87.4	99.7
11.	Oil sardine	-	2.9	-	0.2	-	-	-	-	-	-	-	-	-	-		-	-	3.1	3.1
12.	Black King-fish	-	4.8	2.2	32.0	-	6.4	0.9	0.2	0.4	1.3	9.3	1.0	-	0.1		-	12.8	45.8	58.6
13.	Perches	-	-	0.3	2.0	-	-	-	0.4	1.3	1.6	5.8	2.9	0.3	0.5		-	7.7	7.4	15.1
14.	Miscelleneous	-	1.9	0.5	7.4	-	8.7	8.1	7.9	7.3	5.5	2.9	5.5	2.7	3.8		1.8	21.5	42.5	64.0
15.	Mammals	-	-	3.0	-	7.3	0.2	-	2.0	-	2.5	-	1.5	-	-		-	10.3	6.2	16.5
16.	Turtles	-	0.8	-	0.2	-	-	2.9	1.3	-	1.4	-	2.2	-	-		-	2.9	5.9	8.8
17.	Crabs	-	-	-	-	-	-	-	-	-	-	-	0.8	-	1.4		0.1	-	2.3	2.3
	Total	112.6	333.7	393.9	736.1	320.8	409.2	452.8	489.8	400.6	505.8	210.9	207.5	180.4	148.8	-	30.9	2,072.0	2,861.8	4,933.8

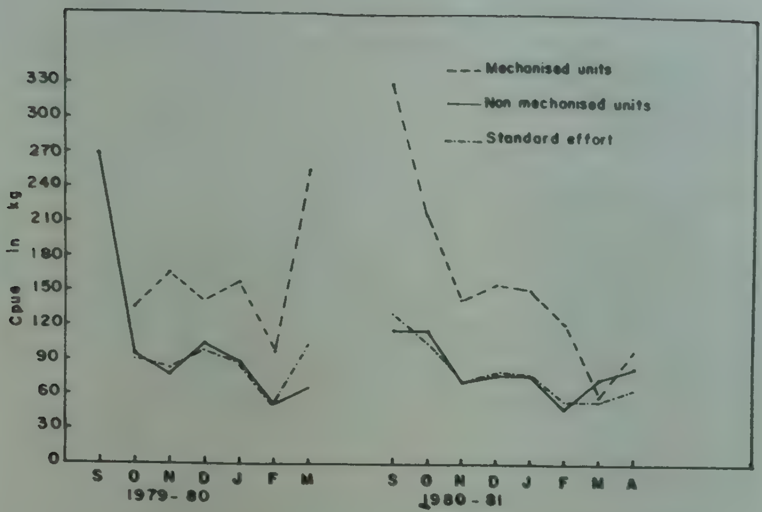


Fig. 4. Month-wise catch per unit effort by drift gill nets during 1979-80 and 1980-81.

gill net catches amounted to 23.4% and 20.5% during 1979–80 and 1980–81 respectively.

In case of spotted seer *S. guttatus* the productive months were October–December and its contribution in seer fish landings amounted to 10% and 9.3% during 1979–80 and 1980–81 respectively. Though the streaked seer *S. lineolatus* was observed in the catches its contribution to the fishery could be considered to be of little significance in view of its meagre catches.

Tunnies

This group formed a fair proportion in the gill net catches. The little tunny *Euthynnus affinis*, the northern bluefin *Thunnus tonggol*, frigate tuna *Auxis thazard*, the bullet tuna *Auxis rochei* together with the oriental bonito *Sarda orientalis* constituted about 4.3% and 3.4% of the total catch of fishes in 1979–80 and 1980–81 respectively. *E. affinis* usually starts appearing in the catches from September and becomes rarer by January. This fish contributed to the tuna catch as high as 92.5% in 1980–81, an increase of about 15.2% over the previous year. The occurrences of *T. tonggol* were rather erratic in nature and its contribution on an average for both years was about 9.4%. An interesting feature of the gill net fishery was the landings of frigate tuna, bullet tuna and oriental bonito, hitherto remained unexploited in the Dakshina Kannada. They collectively formed about 11.7% of the tuna catches in 1979–80, however, declining to 0.4% in the subsequent year.

Bill fishes

So far the potentiality of this resource remained unexploited because of lack of venture of fishermen to deeper waters. The sail fish *Istiophorus platypterus* and the black marlin *Makaira indica* each accounted about 31 tonnes. The catch of the

Table 2. *Species composition of non-mechanised and mechanised gill net catch (in tonnes) in Dakshina Kannada for the years 1979-80 & 1980-81 (pooled)*

	Species	Non-mechanised units	%	Mechanised units	%	Total	%
1.	Seer fish	1,051.5	33.31	507.6	28.56	1,559.1	31.60
2.	Tunnies	133.4	4.22	53.2	3.00	186.6	3.78
3.	Bill fish	50.9	1.61	13.7	0.77	64.6	1.31
4.	Elasmobranchs	736.1	23.32	585.4	32.93	1,321.5	26.78
5.	Cat fishes	584.8	18.53	382.3	21.51	967.1	19.60
6.	Pomfrets	147.3	4.67	71.1	4.00	218.4	4.43
7.	Mackerel	224.3	7.11	48.7	2.74	273.0	5.53
8.	Carangids	26.5	0.84	8.2	0.46	34.7	0.70
9.	Chorinemus	20.1	0.64	20.6	1.16	40.7	0.83
10.	Wolf herring	69.7	2.21	30.0	1.69	99.7	2.02
11.	Oil sardine	3.0	0.10	0.1	0.01	3.1	0.06
12.	Black King-fish	37.1	1.18	21.5	1.21	58.6	1.19
13.	Perches	5.1	0.16	10.0	0.56	15.1	0.31
14.	Miscellaneous	46.7	1.48	17.3	0.97	64.0	1.30
15.	Mammals	14.0	0.44	2.5	0.14	16.5	0.33
16.	Turtles	4.1	0.13	4.7	0.26	8.8	0.18
17.	Crabs	1.7	0.05	0.6	0.03	2.3	0.05
	Total	3,156.3	100.00	1,777.5	100.00	4,933.8	100.00
	No. of units	36,234		11,270		47,504	

latter species which amounted to 10.2 tonnes in 1979-80 showed almost a two fold increase during the subsequent year. Though these fishes occurred during the September-December period it could be said that November formed the most productive month for both species.

Elasmobranchs

The gill net catches invariably were dominated by *Scoliodon sorrakowa*, *Carcharinus limbatus* and *Sphyrna blochii*. Their total catch was as high as 802 tonnes in 1980-81, 35% over the previous year. Their importance could be gauged from the contribution of this group to the total catch which varied from 25% to 28% during the years of observation. Their share to elasmobranch catch was as high as 94% in 1979-80 and maintained the same tempo during the next season also. It is seen from Table 1 that the catches extended from October to March, the most productive month being December.

Cat fishes

This group was represented by *Arius thalassinus*, *A. dussumieri*, *A. serratus* and *A. tenuispinis*. The catch of about 378 tonnes in 1979-80 sharply increased by 29.2% during the subsequent year. They were caught almost throughout the season, however, the middle part of the season accounts for bulk of the catches.

Mackerel

It has to be said that gill net of mesh size 65-135 mm is not definitely meant for small species like mackerel. However, large sized mackerel were often caught and their landings amounted to 190 tonnes in 1979-80 which was almost 1/10 of the total catch of all fish (Table 1). However, the catch decreased by 50% during the next year. They were obtained mainly during December-February period.

Pomfrets

The most sought after fish both for financial returns and gourmet needs are the pomfrets. The catches consisted of the white pomfret, *Pampus argenteus* and black pomfret *Parastromateus niger*, totalling about 71 tonnes in 1979-80 and showing a two-fold rise during the succeeding year. Usually the black pomfrets are caught in good numbers during December-January whereas *P. argenteus* in October.

Carangids

Amongst the carangids the important species are the horse mackerel, *Megalaspis cordyla* and *Carangoides chrysophrys*. Less important were *Chorinemus lysan*, *C. tol* and *Alectis indicus*. Their percentage contribution to the total catch varied from 1.3 to 1.7 during 1979-80 and 1980-81 respectively.

Wolf herring

Chirocentrus dorab and *C. nudus* were observed in the catches. Their catches amounted to 8.7 tonnes during 1979-80, showing an increase of 91% during the next year (Table 1). In both seasons high catches were recorded in December.

Oil sardine

Like mackerel, large-sized oil sardines were also occasionally caught. Their catch was 0.5 tonnes in 1979-80, increasing to 3.1 tonnes in 1980-81.

Black king-fish

Not infrequent was the occurrence of black king-fish (*Rachycentron canadus*). Its estimated catch amounted to about 13 tonnes during the first year, going up by 35% in the next year. In both seasons October appeared to be the productive month for this species.

Sciaenids

This group was represented by *Pseudosciaena diacanthus*, *Otolithes ruber* and *Johnius* spp. The first species dominated the catches in both years. The catch of 1.4 tonnes during 1979-80 increased to 12.5 tonnes in the next year.

Perches

A variety of species constituted this group, the most important in order of abundance being *Lutianus* spp., *Pomadasys hasta*, *Serranus* spp., *Pristipoma typhus*, *Nemipterus japonicus* and *Therapon theraps*. Their contribution however, to the total catch during both years never exceeded more than 1%. These are available in good numbers during the months of January-February.

Miscellaneous fishes

Fishes like Belones, *Sphyraena* spp., *Trichiurus* spp., *Coryphaena* spp., *Megalops cyprinoides*, *Muraenesox talabonoides*, *Lates calcarifer*, *Lobotes surinamensis*, *Polynemids*, *Platycephalus* spp., *Echeneis naucrates*, *Saurida tumbil* and *Chanos chanos* collectively amounted to about 20 tonnes and 27 tonnes in the two years respectively. The first five categories of fish were found to be dominant and they were best obtained during November to January.

Dolphins and porpoises

These are mammals accidently caught when moving in herds. Neverthless their catches amounted to 10.3 and 6 tonnes during 1979-80 and 1980-81 respectively.

Turtles

The peak season for turtle appears to be December. A total of 2.9 tonnes were landed during 1979-80 and in the subsequent year the figure was 5.9 tonnes.

Crabs

About 2.3 tonnes of crabs comprising *Scylla serrata* were caught during January-April period of 1980-81 season.

Marketing and disposal

The fish catches are usually auctioned at the landing centre. For purposes of this study, the information was gathered at the landing centres during the auction time. During 1979-80 the price realised through the sales was Rs 4.5 million whereas in the next year it amounted to Rs 6.7 million (Fig. 5). During the first year seer fishes fetched Rs 1.67 million and it increased to Rs 2.04 million in the following year. Sharks and rays netted Rs 1.41 and 2.13 million in 1979-80 and 1980-81 respectively. Pomfrets fetched Rs 0.07 million in 1980-81 season.

While at Gangoli, Hejmady and Suratkal the fishes are auctioned, at Kaup (Plate 1), the wholesale merchants and fishermen offer mutual discussion through a commission agent agreed upon to fix prices for quality of fish. The prices fluctuate depending upon the quantum and quality of fish available. There is a severe competition among the traders to corner the catches. As such they lure the needy fishermen by making advance payments.

However, at Mangalore a different pattern is followed. To avoid the monopoly of few merchants cornering all the catches at the landing centre (Bunder), a new method has been devised. The catches are removed to the wholesale market in the city which helps the fishermen to get better returns for their hard labour.

Kaup is the biggest fish landing centre in the Dakshina Kannada as far as gill net catches are concerned. Naturally this has generated a lot of employment opportunities among the rural folks. As the landing place at Kaup is rather away from approach road the catches have to be transported by head-load for which purpose invariably women folks are engaged in view of their low wages. Nor-

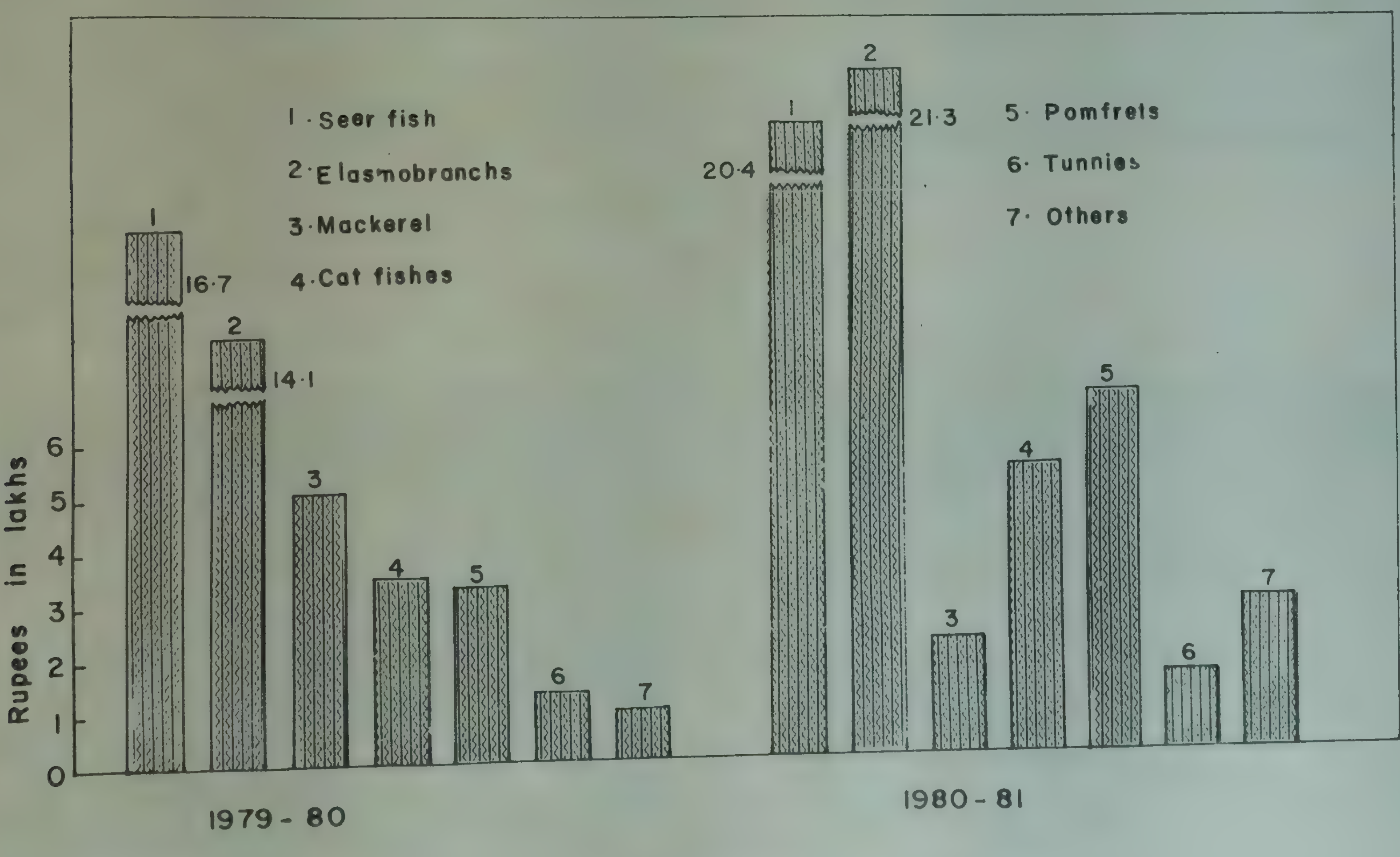
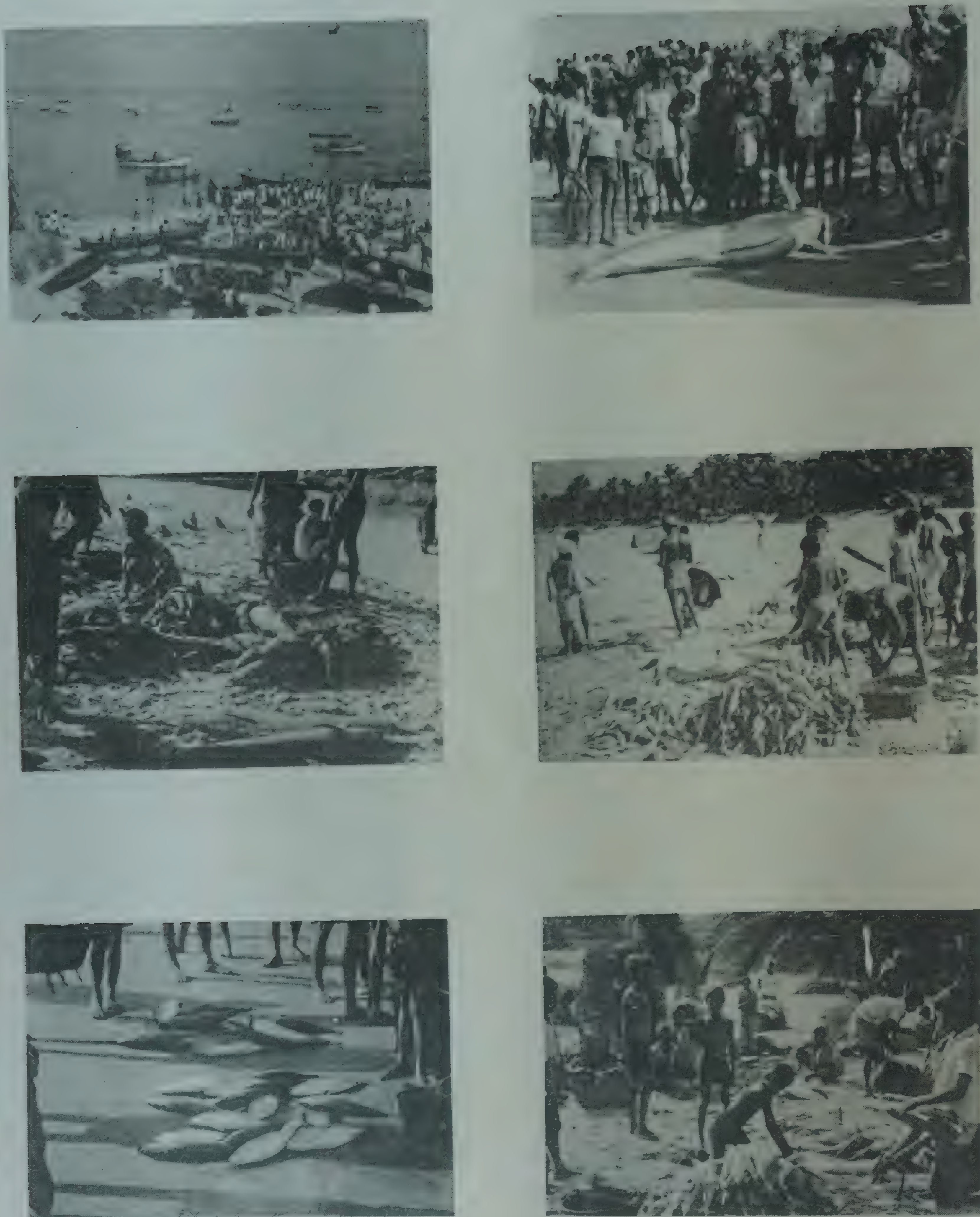


Fig. 5. Value of various fish landed during 1979-80 and 1980-81.



Photographs (Plate I) showing handling of different categories of fishes from the gill net landing centres in South Kanara.

mally half a rupee is paid for each trip for carrying the fish. It is estimated that on an average a women labourer earns about Rs 6-10 per day.

Usually cat fishes, sharks and bill fishes are salt cured. The quality fishes like seer, pomfret and black king-fish are packed in deal wood boxes with ice and transported by lorries to far off places like Bangalore and Madras. Tunas have no local market and as such they are sent to Kerala where there are ready markets for this fish. In spite of the escalation of freight rates by road, merchants churn out handsome profits. In other words, it amply proves how the middle men deprive the fisherfolk of their legitimate financial return for their catch. Hence to safe guard the interest of the toiling fishermen there is an imperative need of setting up of organised marketing agencies either by the Government or co-operative societies or fishermen unions.

General remarks

It is evident from the foregoing account that gill nets in Dakshina Kannada region are playing a major role in the small scale fisheries sector even after the introduction of purse seines. Unlike purse seines the gill nets are presently operated during night, and often for larger and higher value species and hence there exists no competition between these two gears for exploiting the pelagic resources. Considering the present trend of fish catches and financial returns by gill nets it is felt that this class of artisanal fishingoperations could be encouraged to substitute the presently idle indigeneous gears (rampani, shore seine, boat seine etc.). It is encouraging to note that action in this direction has been already taken by some local fishermen by deploying dugout canoes fitted with out-board engines in Dakshina Kannada for going out for drift gill netting. In view of these facts it may safely be stated that there exists a tremendous potential in coastal Karnataka for augumenting the gill net fishing for exploiting under exploited marine resources, thereby increasing fish yields and financial benefits to a large number of people engaged in the artisanal fishery.

NEWS - INDIA AND OVERSEAS

Fisheries development schemes in Kerala State

Several major schemes at an estimated cost of Rs. 700 million with the object of developing fisheries, boosting exports and improving living and working conditions of fishermen in Kerala State, India are being launched by the Kerala Fishermen's Welfare Corporation. The schemes, to be implemented over three years will cover some 265 coastal villages and envisage mechanisation of fishing craft, replacement of wooden boats by fibre glass ones and diversification of fishing techniques for fuller exploitation of marine resources. Boats, nets and other fishing equipments, subsidised by the Corporation, will be supplied to the fishermen. Effective steps will also be taken to avoid exploitation of fishermen by middlemen and all the development assistance will be channelled through fishermen's Co-operative Societies. Construction of 15,000 houses in addition to the 10,000 houses now under construction for fishermen forms part of the schemes. Long term loans to fishermen at nominal rates of interest are also envisaged.

Electromagnetic aid for lobster research

A young Australian scientist has devised a tiny electromagnetic "bug" for studying the behaviour and movement of the spiny lobster on the west coast of Victoria. The device is carried in a saddle attached to the back of the lobster.

Ultrasonic devices with which experiments have been conducted to study the animals in their open habitats have been proved not very useful as they transmit their signals only in straight lines. So the idea of using electromagnetic devices came up and this has been developed. The signals from the device can penetrate

sea water, rocks and most other substances except steel. A saddle carrying the device has been designed and this sits firmly on the hard back of the carapace of the lobster. The saddle contains the electromagnetic tag, which is a tiny pellet of diameter 46 mm and 10 mm thick, weighing 8 g when in sea water. It contains a tiny battery-powered device which transmits a low-frequency, electromagnetic pulse.

Signals from the pellet are received by an observer in a boat using a miniature receiver, which accepts signals via either a small antenna or via submersible copper wire loops. Since each electromagnetic tag is on a different pulse rate it is possible to identify each individual lobster. However, there are practical difficulties encountered in the field experiments conducted with this device. One of the problems is the life time of the battery and the second is that lobsters, as in the case of other crustaceans, shed their hard shells periodically.

FNI 19 (12) : December 1980

Wave-powered boat

A series of successful tests carried out by Norwegian researchers in the experimental model tanks in Trondheim are showing bright prospects of boats upto 50 m length being propelled by wave energy.

Briefly, the system comprises a movable foil (a water wing) placed horizontally on an axis beneath the boat. This moves up and down in step with the movements of the boat in the waves. It is in fact more effective against wave direction than with it. These conceptual vessels could, if proved eventually, have considerable significance for some sections of the fishing industry.

FNI 20 (1) : January 1981

Seadog or fish hotdog developed

Canadian researchers have developed "the seadog" otherwise known as the fish frankfurter or fish hotdog. This is reported to be a cheaper, less fattening, more nutritious and easier to digest compared to the red meat hotdog.

The seadog is made of cod, squid, non-fat dry milk, corn oil, seasoning and preservative, moulded into hotdog form, steamed for 7 minutes and then cooled. A team of taste-testers have scrutinised and certified the product for colour, chewiness, elasticity, after taste and particle size. The cost would be about 1.40 dollars compared to 1.89 to 2.19 dollars for hotdogs. This is the first time a fish hotdog has been developed, although Japan and the Soviet Union have seafood sausages. The product is higher in protein content than the hotdog, has Vitamin A, which hotdogs do not have and contains about 80 calories a seadog as against 134 calories for a redmeat hotdog.

FNI 20 (1) : January 1981

Potential resources of lantern fish

Canada's International Development Research Centre (IDRC) reports about the existence of large resources of lantern fish in the western part of the Arabian Sea. This has been brought to light by the cruises of a Norwegian research vessel in an expedition sponsored by the United Nations.

As small as a sardine, but resembling a trout, the glow-in-the dark lantern fish is a deep water bottom fish. The protein value of the fish was ignored by the fishing industry till the results of the expedition came in. Since the same fish inhabits all the major oceans of the world, scientists speculate that annual harvests of this fish could substantially increase the current world fish production.

Much remains to be learned about the best way to use lantern fish as a food source. However, the United Nations is supporting exploration for the fish in the Indian Ocean, off the Atlantic coast of Africa and in the South China Sea.

International Exchange News 25 (2) : 1981

Built-in compass for migrating fishes

One of the theories about animal migration is that internal magnets may be synthesised to assist accurate navigating over long distances. Migratory birds have revealed an ability to use the geomagnetic field of the earth to guide their travel. But there was no known biological mechanism through which migratory animals might detect and use earth's geomagnetic field. However, recently a number of animals have been found to possess microscopic iron-rich particles. These tiny particles, which react like simple compass needless to the earth's magnetic field, may be the sensory mechanism responsible for the incredible migratory behaviour of some animals.

Studies conducted at the Honolulu Laboratory of the U. S. National Marine Fisheries Service on tunas and green turtles is showing promising leads in this direction. Numerous magnetic crystals have been located in the heads of these animals, enough to provide them with an extremely accurate magnetic "map" sense. The magnetic crystals in the yellow fin, skipjack and other species of tunas were located in or upon the frontal bone of the skull. Experiments have also revealed an unconditioned magnetic response in yellow fin tuna.

FNI 20 (1) : January 1981

BOOKS

Oceanography from space: Ed by J. F. R. Grower, Plenum Press, New York, pp 978, 1981.

This is the thirteenth volume of the series Marine Science. The volume is based on the proceedings of the COSPAR/SCOR/IUCRM Symposium on the same topic held in May 1980 in Venice. The papers give the variety of measurement techniques available or possible, and many of the types of studies in which they can be used. Papers are arranged in a general section and six specialized sections viz. satellite sea surface temperature measurements, water colour measurements, radar studies of the sea surface, passive microwave observations, remote sensing of ice and satellite altimetry. Each section starts with a brief introduction summarising important results. The capabilities of space sensors demonstrated by satellites like SEASAT and Nimbus-7 led many authors to plan enthusiastically for use of National Ocean Satellite System (U.S.) data which has ocean microwave sensors.

Marine Algae from Karachi: By Pyare Lal Anand, Sushma Publications, Dehra Dun, India, pp 128, 1981.

This book is divided into two parts dealing with Green Algae, *Chlorophyceae* and Red Algae *Rhodophyceae*. The author has studied the marine plants from the Karachi coast both from taxonimic and ecological points of view. Although the author has collected the material from various localities such as the rocky ledge at Manora, the buoys, piers and wharves near Manora and the Kemari harbour, sea beaches at Sandpit and Baba Island and the water channels in the adjoining salt marshes, he has limited the studies to the rocky ledge stressing more detailed ecological aspects with a view to obtain more knowledge of the vegetation and of the conditions influencing its distribution. The book is well illustrated.

Aerial photography: By G. S. Kumar, Sudarshan Publishers, Hyderabad, India, pp 293, 1981.

This is the first book on Aerial photography by an Indian author. Aerial photography is a modern science with wide applications in various fields of development. It is being increasingly used all over the world for mapping and making inventories of earths resources. It is an established fact that the use of aerial photographs, results not only in the saving of finances and time but also improves efficiency. In spite of the advantages of satellite imagery for repetetive and extensive coverage, aerial photography, being on a large scale with greater details will continue to provide useful information about the earth and its resources, essential for various types of intensive planning and developmental activities. This is an useful book for students, teachers and professionals associated with aerial photography.

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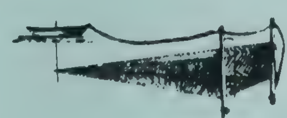

Compiled and prepared by M. J. George and G. Subbaraju.
Published by Dr. M. J. George, Senior Scientist on behalf of the Director, Central Marine Fisheries Research Institute, Cochin-682 018. Phototypeset and printed at PAICO, Cochin 31

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1. The present status of small-scale traditional fishery at Vizhinjam
2. Mechanisation of indigenous crafts with outboard motors in Tamil Nadu—An impact study
3. News—India and overseas

Cover photo: Fish landing centre at Vizhinjam

THE PRESENT STATUS OF SMALL-SCALE TRADITIONAL FISHERY AT VIZHINJAM*

Introduction

Vizhinjam, situated at Long. 76°59′15″E, Lat. 8°22′30″, and 16 km south of Trivandrum, is an important fish landing centre among the twenty-seven fish landing villages in the fishery zone extending from Kollangode in the south to Valiaveli in the north, spanning a distance of about 50 km on the south-west coast of India. Owing to its location which affords facilities for putting the boats out to the sea even in the monsoon season, as well as due to good marketing outlets at nearby places such as Balaramapuram, Trivandrum and adjacent towns, fishing activity takes place in the Vizhinjam area all through the year. With the completion of the Vizhinjam Fishing Harbour which is underway, the fisheries importance of this area is bound to increase further. Vizhinjam is thus at the threshold of modernization and expansion of its fishing activities, particularly with reference to exploitation of the deep-sea fishery resources. An account of the present status of the traditional fishery of the Vizhinjam area is therefore timely.

Annual production

Data collected over a period of 12 years, from 1968 to 1979, have been analysed for this study. Table 1 gives the gearwise annual effort (E) (that is the number in each type of gear employed in fishing), catch (C) in tonnes, and catch per unit effort (C/E) in kg (which is the catch per net or the catch per set of three or four numbers of hook and line operated from a single catamaran, per fishing trip lasting for 4 to 24 hours), the annual average catch and the efficiency factor of each gear in relation to the catch per unit effort (C/E) of boat seine which, being the most important gear, is taken as the standard gear. The table also furnishes the annual total catch landed by all gears, the standard effort, SE, (which is obtained by multiplying the effort of each type of gear by its relative efficiency with reference to boat seine and totalling them) as well as the annual catch per standard effort (C/SE) during the period from 1968 to 1979.

The data shows that the annual marine fish landings at Vizhinjam ranged from 1,497 tonnes in the year 1975 to 8,506 tonnes in the year 1978 with the annual average at 4,525 tonnes. The average monthly landings varied between 147 tonnes in February and 750 tonnes in July with the overall monthly average at 377 tonnes. Fish landings higher than this monthly average were obtained during June to October, when nearly 60% of the annual catch was landed. The monthly trends of total fish landings, standard effort and catch per standard effort are given in Fig. 1. It may be seen from the figure that the effort was fairly high from April to November, and the catch per standard effort, barring for January, was higher than its annual average of 62.6 kg during July, September and October. The highest C/SE of 171 kg seen in Fig. 1. for January was due to an unusually high catch of 548 tonnes of *Loligo* spp. recorded in boat seine at a catch rate of 310 kg and 161 kg per net in two consecutive observation days (6th and 10th January 1972). If the average catch for the month of January for the other years (excluding 1972) is substituted for this month, the average C/SE for January would work out to 13.5 kg only. From the foregoing trends it may be stated that June to October represents the main fishery season with best returns in October in the Vizhinjam area.

The chief craft employed for fishing at Vizhinjam is the catamaran, the next important one being the dugout canoe. In recent years, however, a few mechanized boats have started operating in the area using the traditional drift net. At present eleven types of gears are employed in this area to exploit its fishery resources. Of these, the boat seine (*Thattumadi*) contributes to the bulk (47.9%) of the total fish landings followed by hook and line (locally known as Choonda) 22.7% and drift net (locally known as *Pattyvala)* 16.6%. The other gears and their contributions are: *Chala vala* (gill net)–4.3%, *Katchal* (scoop net using bait)–

*Prepared by G. Luther, P. N. Radhakrishnan Nair, G. Gopakumar and K. Prabhakaran Nair. Basic data of this account was collected and maintained by S/Shri P. S. Sadasiva Sarma, T. A. Omana, J. J. Joel, S. G. Vincent, (Late) K. Rajasekharan Nair, A. K. Velayudhan, Mathew Joseph and K. T. Thomas.

Table 1. *Gear-wise annual effort, catch (tonnes) and catch per unit effort (kg), annual average catch (tonnes) and the efficiency factor in relation to boat seine along with yearly total catch (tonnes), standard effort and catch per standard effort (kg) for the period 1968–1979.*

Sl. No.	Gears	Effort Catch & C/E	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	Annual average (tonnes)	Relative efficiency
1.	Boat seine	E	28,734	27,199	40,425	37,320	30,929	39,728	46,319	33,595	21,774	9,710	51,324	47,794	34,571	
		C	1,309.0	1,050.9	1,771.9	2,056.1	1,926.9	2,781.1	2,707.2	748.6	1,792.9	780.7	5,180.6	3,883.6	2,165.8	
		C/E	45.6	38.6	43.8	55.1	62.3	70.0	58.5	22.3	82.3	80.4	100.9	81.3	62.6	1.00
2.	Hook & Line	E	21,911	30,784	55,179	66,640	64,985	47,946	59,629	49,022	72,271	44,310	69,508	51,115	52,775	
		C	493.5	737.4	1,599.8	1,637.9	1,475.4	791.2	1,007.4	432.7	1,066.5	793.7	1,461.1	840.6	1,028.1	
		C/E	22.5	24.0	29.0	24.6	22.7	16.5	16.9	8.8	14.8	17.9	21.0	16.4	19.5	0.31
3.	Drift net	E	8,922	10,350	16,605	15,249	25,663	22,370	12,943	12,081	21,883	18,130	21,183	14,259	16,636	
		C	254.1	338.3	854.1	962.3	1,034.9	1,437.8	549.0	147.7	1,181.0	837.4	836.2	580.8	751.1	
		C/E	28.5	32.7	51.4	63.1	40.3	64.3	42.4	12.2	54.0	46.2	39.5	40.7	45.2	0.72
4.	Chala vala	E	4,655	3,570	10,993	4,576	7,176	11,484	14,738	11,822	10,666	5,717	22,985	15,093	10,290	
		C	86.6	91.9	163.3	207.3	180.8	218.7	379.6	119.4	164.8	105.8	410.2	226.2	196.2	
		C/E	18.6	25.7	14.9	45.3	25.2	19.0	25.8	10.1	15.5	18.5	17.9	15.0	19.1	0.31
5.	Katchal	E	6,506	2,657	1,318	Not operated	6,894	Not operated	Not operated		4,456	5,043	Not operated		4,479	
		C	153.2	61.6	25.0		782.5				197.3	172.1			232.0	
		C/E	23.5	23.2	19.0		113.5				44.3	34.1			51.8	0.83
6.	Shore seine	E	6,286	3,449	2,011	1,302	622	746	1,475	979	1,154	658	2,448	2,416	1,962	
		C	180.7	226.3	93.1	150.8	64.1	78.7	126.4	36.3	58.3	28.5	148.6	131.3	110.3	
		C/E	28.8	65.6	46.3	115.9	103.0	105.5	85.7	37.1	50.5	43.3	60.7	54.4	56.2	0.90
7.	Netholi vala	E	2,459	3,392	2,900	2,691	5,259	2,511	1,014	Not operated	911	206	983	378	2,064	
		C	32.5	52.4	40.1	57.0	290.2	153.3	29.0		24.8	3.1	75.1	15.0	70.2	
		C/E	13.2	15.5	13.8	21.2	55.2	61.0	28.6		27.3	15.1	76.4	39.6	34.0	0.54
8.	Konchu vala	E	Not operated							1,643	2,303	1,292	18,072	12,930	7,248	
		C								10.9	14.3	21.3	302.1	132.9	96.3	
		C/E								6.6	6.2	16.5	16.7	10.3	13.3	0.21
9.	Nandu vala	E	Not operated			959	167	3,603	867	Not operated			1,031	2,043	1,445	
		C				26.6	2.8	169.6	20.9				40.9	39.9	50.1	
		C/E				27.8	16.6	47.1	24.1				39.7	19.6	34.7	0.55
10.	Kolachi vala	E	Not operated			111	2,189	1,841	Not operated	150	667	423	1,298	517	900	
		C				1.3	83.0	94.5		1.5	10.6	6.6	51.1	12.4	32.6	
		C/E				11.9	37.9	51.3		9.8	15.8	15.7	39.4	24.0	36.3	0.58
11.	Achil	E	Not operated				861	2,820	969	Not operated		2,241	Not operated		1,723	
		C					5.9	20.6	21.4			23.2			17.8	
		C/E					6.9	7.3	22.1			10.3			10.3	0.16
Annual total catch (C) (tonnes)			2,509.6	2,558.8	4,547.4	5,098.8	5,846.5	5,745.5	4,840.9	1,497.1	4,511.2	2,772.3	8,505.9	5,862.6	4,524.7	
Standard Effort (SE)			55,055	66,308	1,03,797	92,582	93,832	82,074	82,806	67,084	54,844	34,472	84,281	72,112	72,254	
C/SE in kg			45.6	38.6	43.8	55.1	62.3	70.0	58.5	22.3	82.3	80.4	100.9	81.3	62.6	

Note: E = Effort; C = Total catch in tonnes; C/E = Catch per unit effort in kg; C/SE = Catch per standard effort in kg.

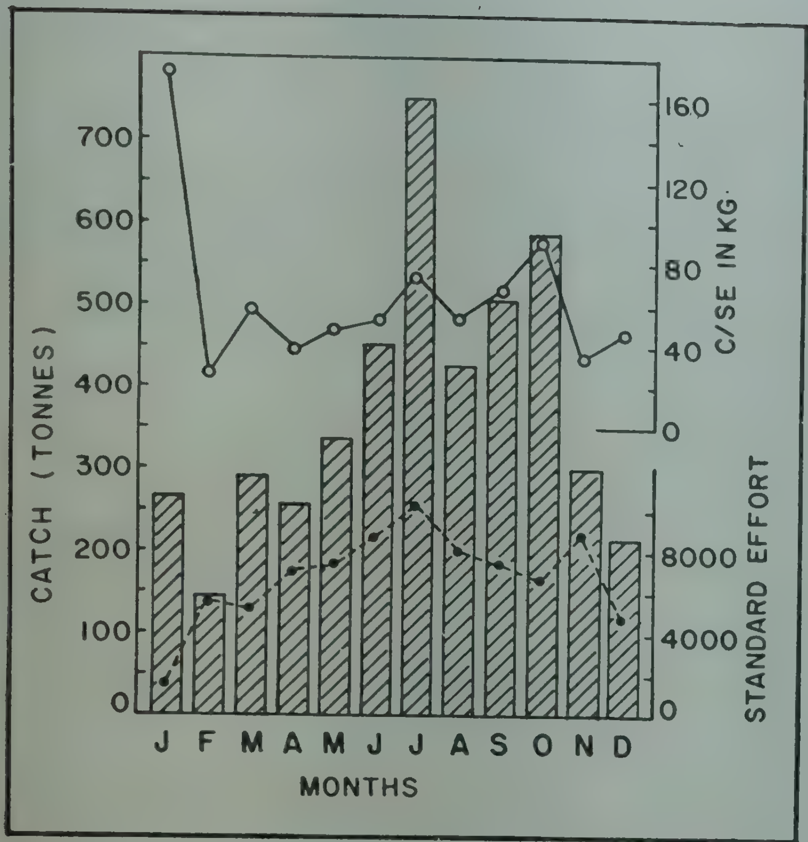

Fig. 1. The average monthly trends of total fish landings, standard effort and catch per standard effort (C/SE) at Vizhinjam during 1968–1979.

2.6%, Shore seine locally known as *Kamba vala)*-2.4%, *Netholi vala* (gill net)-1.4%, Konchu vala (gill net)- 0 9%, Nandu vala (Bottom-set gill net)–0.6%, *Kolachi vala* (a variation of boat seine with strips of palmyrah leaves stuck along the float line and the warp and operated both in the surface water as well as from the shore)–0.5%, and *Achil* (a hand line with smaller hooks closely set at the end of the line together with artificial bait, a variation of the hook and line)–0.1%. Details of the common nets employed at Vizhinjam, together with the mode of their operations are given by Nayar (*Indian J. Fish.*, 1958, 5 (1): 32–55) and Bennet (*J. Bombay Nat. Hist. Soc.*, 1967, 64 (2): 377-380).

Gearwise production

The yearly total catch of the important groups of fish forming about 1% or more in each gear, together with their annual average percentage composition in the landings by that gear and the rank are presented in Tables 2–12. Monthly trends of operation of different gears (E) together with their catch (C) and the catch per unit effort (C/E) are given in Figs. 2 and 3. In the following account the trends of fisheries by different gears are given.

Boat seine: Boat seine was operated in all the years from 1968 to 1979. The number of units employed ranged from 9,710 in 1977 to 51,324 in 1978 with the average at 34,571 units per year. This wide range in the number of boat seines operated was mainly due to the variation in the migration of fishermen with their craft and gear into Vizhinjam area during periods of good fishery, particularly during June–August. Further, going for more than one trip of fishing in the same day, usually two or three trips, when the fishery was good and the fishing ground was near, also contributed to this variation in the number of units operated. Occasionally a catamaran merely lands the catches, like the carrier boat of purse seine, while operation of boat seine is being continued by two other catamarans. The total catch ranged from 748.6 tonnes in 1975 to 5,180.6 tonnes in 1978. The annual average catch was 2,165.8 tonnes. The range of annual C/E was between 22.3 kg in 1975 to 100.9 kg in 1978, with the average (over the whole period) at 62.6 kg.

Though boat seine was operated almost throughout the year, about 82% of its annual effort was expended during June–September when 81% of the catch by this gear was landed, with the monthly C/E ranging between 50.8 kg and 74.1 kg (Fig. 2A). It may be mentioned here that the seasonal trend of the fishery at Vizhinjam generally coincides with the trend of the fishery by boat seine.

Trichiurus was the most dominant group of fish caught in boat seine accounting for 45.8% of the average annual catch followed by *Stolephorus* (8.6%), carangids (8.5%) and leiognathids (7.3%). Other important groups met with were squids, sardines, cat fish, *Dussumieria,* sciaenids, perches, *Acetes,* goat fishes, *Lactarius* and mackerel in that order (Table 2).

Hook and line: Hook and line was operated in all the years from 1968 to 1979. The annual effort ranged between 21,911 units in 1968 and 72,271 units in 1976 with the average at 52,775 units. Thus, the hook and line is the most commonly used gear as it requires minimum capital expenditure. The total catch ranged from 432.7 tonnes in 1975 to 1,637.9 tonnes in 1971 with the average at 1,028.1 tonnes. The annual C/E varied from 8.8 kg in 1975 to 29 kg in 1970 with the annual average at 19.5 kg. The relative efficiency of this gear was 0.31.

Fishing by this gear is carried out throughout the year, but it is more intense during January–May and September–December, when 49% and 34% respectively of the annual effort is expended, landing 48% and 37% respectively of its annual catch with the monthly

Table 2. *Catch composition of important groups of fish (tonnes) during the year 1968–1979 in Boat seine*

Groups	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	Average	%	Rank
Trichiurids	471.7	74.9	364.1	741.9	458.1	1,028.8	726.8	429.2	723.2	331.7	3,298.7	3,250.9	991.7	45.8	1
Stolephorus	137.0	53.5	296.1	178.5	129.8	468.0	304.5	82.2	119.2	89.2	335.4	34.2	185.6	8.6	2
Leiognathids	84.0	69.0	127.7	99.3	204.2	317.3	699.0	23.4	72.1	14.7	159.7	34.5	158.8	7.3	3
Decapterus	34.7	165.0	57.4	100.9	16.7	44.4	146.4	14.3	41.3	28.9	324.8	197.5	97.7	4.5	4
Squids	55.3	11.5	16.7	3.9	678.7	20.4	22.4	28.0	45.3	5.7	116.9	138.2	95.2	4.4	5
Other carangids	48.0	32.2	78.0	178.9	70.9	179.2	246.9	14.8	89.6	37.2	43.2	31.1	87.5	4.0	6
Cat fish	92.6	36.2	14.1	274.6	14.4	39.6	5.3	21.5	169.6	5.7	73.7	38.4	65.5	3.0	7
Dussumieria	65.4	36.0	196.6	29.7	2.5	28.7	143.1	8.8	18.0	2.3	165.7	0.4	58.1	2.7	8
Sciaenids	42.7	69.9	73.4	53.0	14.8	4.4	42.7	20.3	40.6	10.2	238.8	28.4	53.3	2.4	9
Lesser sardines	19.1	17.0	63.0	66.9	25.4	147.6	32.6	14.4	116.3	25.8	8.2	74.9	50.9	2.4	10
Perch-like fishes	47.6	159.4	55.3	14.8	50.1	90.4	96.9	15.8	17.8	0.5	27.0	18.4	49.5	2.3	11
Acetes	—	—	130.8	1.1	41.3	206.3	37.1	28.6	0.2	8.4	115.3	5.7	47.9	2.2	12
Goat fish	87.2	195.5	69.8	57.2	43.7	3.7	1.2	0.3	0.9	—	13.1	—	39.4	1.8	13
Mackerel	10.6	29.3	30.2	91.4	24.5	15.4	25.4	9.0	31.9	28.5	56.2	0.9	29.4	1.3	14
Oil sardine	—	—	—	14.4	5.3	17.7	0.5	9.4	179.2	115.7	3.4	—	28.8	1.3	15
Lactarius	43.9	26.5	62.4	24.3	54.5	31.0	13.0	4.5	33.4	2.6	45.4	0.1	28.4	1.4	16
Miscellaneous	69.2	75.0	136.3	125.3	92.0	138.2	163.4	24.1	94.3	73.5	155.1	30.1	98.0	4.5	—
Total	1,309.0	1,050.9	1,771.9	2,056.1	1,926.9	2,781.1	2.707.2	748.6	1,792.9	780.6	5,180.6	3,883.6	2,165.7		

Table 3. *Catch composition of important groups of fish (tonnes) during the year 1968–1979 in Hook and line*

Groups	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	Average	%	Rank
Other carangids	55.0	102.4	288.5	146.7	165.6	121.6	156.8	44.5	111.5	49.6	178.8	88.4	125.8	12.2	1
Nemipterus	74.4	67.4	112.2	217.2	64.3	73.4	108.1	36.9	133.6	50.2	141.4	48.6	94.0	9.1	2
Cuttle fish	126.1	0.3	35.0	166.0	208.7	24.9	11.1	95.2	115.4	95.1	129.2	99.2	92.2	8.9	3
Magalaspis	6.6	178.9	206.4	185.5	198.4	79.5	55.5	4.5	2.0	36.1	38.6	31.8	85.3	8.3	4
Cat fish	46.2	93.5	149.1	256.4	91.0	77.0	177.8	17.2	58.6	9.9	31.0	13.9	85.1	8.3	5
Euthynnus	39.5	67.7	235.4	92.9	75.5	69.9	108.8	35.7	86.8	21.7	16.4	77.5	77.3	7.5	6
Balistids	—	0.4	3.9	25.3	169.2	52.4	2.4	10.6	94.1	33.7	118.2	5.4	68.0	6.6	7
Decapterus	—	7.3	57.7	106.1	40.3	22.0	107.2	21.5	61.4	3.2	75.5	103.8	50.5	4.9	8
Lethrinids	5.9	26.4	52.2	57.4	87.7	30.9	19.0	15.2	7.4	13.7	181.3	23.0	43.3	4.2	9
Sharks	33.9	45.5	107.9	60.8	30.3	63.8	3.7	9.8	27.0	9.3	35.6	12.1	36.6	3.6	10
Saurida	25.2	21.1	28.4	54.8	28.1	13.2	48.2	15.6	72.7	20.8	62.0	15.5	33.8	3.3	11
Other perch-like fishes	10.1	25.5	16.8	77.6	18.0	34.2	14.0	3.6	26.0	4.3	119.6	30.5	31.7	3.1	12
Lutianids	20.3	23.2	47.8	35.1	98.1	2.0	27.2	12.8	24.0	13.4	69.7	19.4	32.8	3.2	13
Coryphaena	13.6	15.3	10.4	21.1	100.4	30.2	32.1	19.7	66.6	22.3	17.6	7.7	29.8	2.9	14
Trichiurids	—	—	—	—	6.9	—	79.0	1.6	16.8	2.7	2.5	176.1	23.8	2.3	15
Other tunas	12.2	—	16.6	17.2	3.8	8.9	10.0	6.5	26.7	1.4	53.3	5.4	13.5	1.3	16
Miscellaneous	24.5	62.5	231.5	117.8	89.0	87.3	46.5	81.8	135.9	106.3	190.4	82.3	104.6	10.2	—
Total	493.5	737.4	1,599.8	1,637.9	1,475.4	791.2	1.007.4	432.7	1.066.5	793.7	1,461.1	840.6	1,028.1		

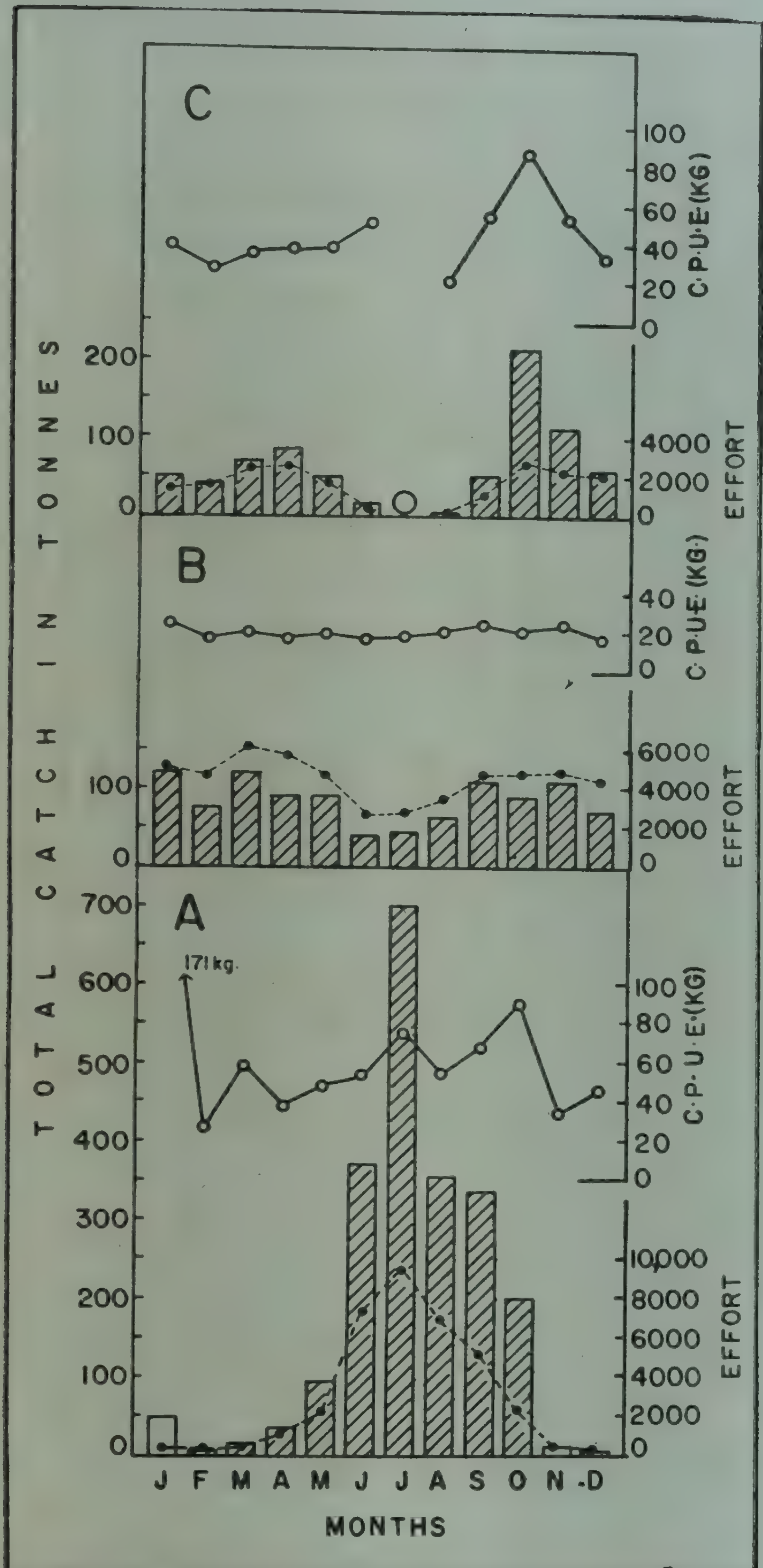

Fig. 2. The gearwise average monthly trends of catch, effort and catch per unit effort (C.P.U.E.) at Vizhinjam during 1968–1979. Open circle on the base line indicates that the gear was not operated during that month. A. Boat seine, B. Hook and line, C. Drift net.

C/E ranges of 15.2 kg–23.3 kg and 16.4 kg–23.9 kg respectively during the two seasons (Fig. 2B).

Among the catches of this gear, carangids accounting for about 25% form the dominant group followed by nemipterids (9.1%), cuttle fish (8.9%), tunas (8.8%), cat fish (8.3%), others being lethrinids, sharks, *Saurida*, lutianids, perches, *Coryphaena* and *Trichiurus* (Table 3).

Drift net: The drift net was operated in all the years during 1968–1979. The total number of units operated each year varied from 8,922 in 1968 to 25,663 in 1972 with the average at 16,636. Minimum values for catch (147.7 tonnes) and C/E (12.2 kg) were noticed in 1975 and the maximum in 1973 the respective values being 1,437.8 tonnes and 64.3 kg. The annual average catch and C/E were 751.1 tonnes and 45.2 kg respectively. The relative efficiency factor of this gear was 0.72.

Fishing by drift net also is carried out throughout the year except during July and in some years August, and it is intense during February–May and October–December periods when 44% and 40% respectively of the annual effort is expended accounting for 32% and 52% respectively of the annual catch, with the monthly C/E ranges of 26.1–35.5, kg and 31.1–85.1 kg respectively during the two seasons, October being the best season for the drift net fishery (Fig. 2C).

Tunas (*Euthynnus, Auxis, Sarda* and others) accounting for 39.3% form the dominant catch in this gear, followed by carangids (18.8%) seer fish (13.5%) and elasmobranchs (6%); others being mackerel, cat fish, lethrinids *Sphyraena* and *Chirocentrus* (Table 4).

'Chala vala': Chala vala also was operated in all the years. The number of units operated ranged between 4,576 in 1971 and 22,985 in 1978, with the average at 10,290. The total catch varied between 86.6 tonnes in 1968 to 410.2 tonnes in 1978, with the average at 196.2 tonnes. The annual C/E ranged from 10.1 kg in 1975 to 45.3 kg in 1971 with the average at 19.1 kg. The relative efficiency of this gear was 0.31.

Fishing by Chala vala is carried out throughout the year except for July and August, and it is intense during March–May and November–December when 57% and 21% respectively of the annual effort was expended, accounting for 50% and 26% respectively of the annual catch with the monthly C/E ranges of 12.0 kg–20.1 kg and 20.5 kg-24.8 kg respectively during the two seasons (Fig. 3A).

Sardines dominated by *Sardinella gibbosa* form the dominant catch accounting for 80.5%, followed by *Dussumieria* (5.5%) and leiognathids (5.2%); others being carangids and *Sphyraena* (Table 5).

'Katchal': During the period 1968–1979, Katchal was operated only for six years at times of abundance

Table 4. *Catch composition of important groups of fish (tonnes) during the years* 1968–1979 *in drift net.*

Groups	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	Average	%	Rank
Euthynnus	64.6	89.8	212.6	194.9	190.2	221.5	117.2	21.6	193.7	198.8	91.1	101.6	141.5	18.8	1
Auxis	40.5	9.7	207.4	159.0	213.2	227.6	43.5	18.4	191.2	178.1	230.4	54.2	131.1	17.5	2
Seer fish	32.6	27.3	21.2	125.7	123.9	247.4	83.6	22.8	235.1	113.3	96.1	88.7	101.5	13.5	3
Caranx sp.	29.0	41.3	55.5	59.3	137.4	150.7	98.4	11.5	98.9	69.3	100.4	56.9	75.7	10.1	4
Megalaspis	14.6	41.8	63.4	92.0	137.7	286.3	20.5	1.2	21.3	9.1	5.2	3.4	58.1	7.7	5
Sharks	17.4	14.7	20.5	26.1	35.7	28.2	4.1	7.4	74.3	74.2	74.8	30.5	34.0	4.5	6
Mackerel	6.0	36.7	41.4	55.2	24.7	28.7	16.5	15.4	24.4	27.5	27.1	22.9	27.2	3.6	7
Cat fish	3.0	2.3	37.7	—	53.7	24.9	21.0	5.8	33.8	7.2	32.3	10.3	19.3	2.6	8
Lethrinids	5.9	3.8	15.5	13.0	32.7	42.5	16.5	3.5	22.3	44.1	5.3	11.4	18.0	2.4	9
Sphyraena	—	2.4	9.5	18.1	15.4	14.6	37.7	0.9	22.1	33.2	33.4	17.6	17.1	2.3	10
Chirocentrus	9.1	13.7	15.8	118.0	1.7	3.6	16.2	1.1	3.0	0.4	13.5	7.0	16.9	2.2	11
Istiophorus	—	2.6	31.6	4.0	2.8	36.7	9.1	4.5	60.2	14.0	4.4	4.1	14.5	1.9	12
Tylosurus	—	6.6	14.7	0.9	0.4	13.2	1.9	6.1	89.6	10.7	2.7	6.1	12.7	1.7	13
Rays	10.4	4.5	17.8	4.1	5.1	3.5	11.1	6.0	1.8	14.5	29.0	29.8	11.5	1.5	14
Sarda	—	—	—	—	—	—	1.3	—	23.1	3.2	12.1	94.3	11.2	1.5	15
Other tunas	—	—	1.7	0.6	15.7	36.5	5.9	0.8	63.4	2.8	3.5	2.7	11.1	1.5	16
Lutianids	13.2	15.2	4.8	5.5	5.3	45.8	5.6	2.6	3.4	9.6	8.2	12.0	10.9	1.5	17
Other carangids	4.5	11.3	18.1	12.4	10.5	1.8	6.9	1.4	7.7	6.8	4.6	4.3	7.5	1.0	18
Other perch-like fishes	—	11.0	19.1	6.5	9.6	9.0	14.4	3.6	1.2	2.1	3.3	1.5	6.8	0.9	19
Miscellaneous	3.3	3.6	45.8	67.0	19.2	15.3	17.6	13.1	10.5	18.5	58.9	21.5	24.5	3.3	—
Total	254.1	338.3	854.1	962.3	1,034.9	1,437.8	549.0	147.7	1,181.0	837.4	836.2	580.8	751.1		

Table 5. *Catch composition of important groups of fish (tonnes) during the years* 1968–1979 *in Chala vala.*

Groups	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	Average	%	Rank
Lesser sardines	80.9	85.3	131.5	174.2	161.3	210.5	252.9	94.5	130.7	90.4	287.1	151.4	154.2	78.6	1
Dussumieria	5.1	6.6	21.9	9.8	3.3	—	45.3	7.0	5.1	0.8	16.5	7.2	10.7	5.5	2
Leiognathus	—	—	0.7	—	6.2	7.8	44.1	1.6	5.8	0.2	33.9	22.9	10.3	5.2	3
Oil sardine	0.6	—	—	1.0	—	—	3.7	5.0	16.3	12.3	6.0	—	3.7	1.9	4
Carangids	—	—	0.8	8.6	—	0.4	1.1	2.6	1.9	—	14.3	10.1	3.3	1.7	5
Sphyraena	—	—	—	1.4	—	—	5.9	—	—	—	9.5	9.4	2.2	1.1	6
Miscellaneous	—	—	8.4	12.3	10.0	—	26.6	8.7	5.0	2.1	43.0	25.2	11.8	6.0	—
Total	86.6	91.9	163.3	207.3	180.8	218.7	379.6	119.4	164.8	105.8	410.3	226.2	196.2		

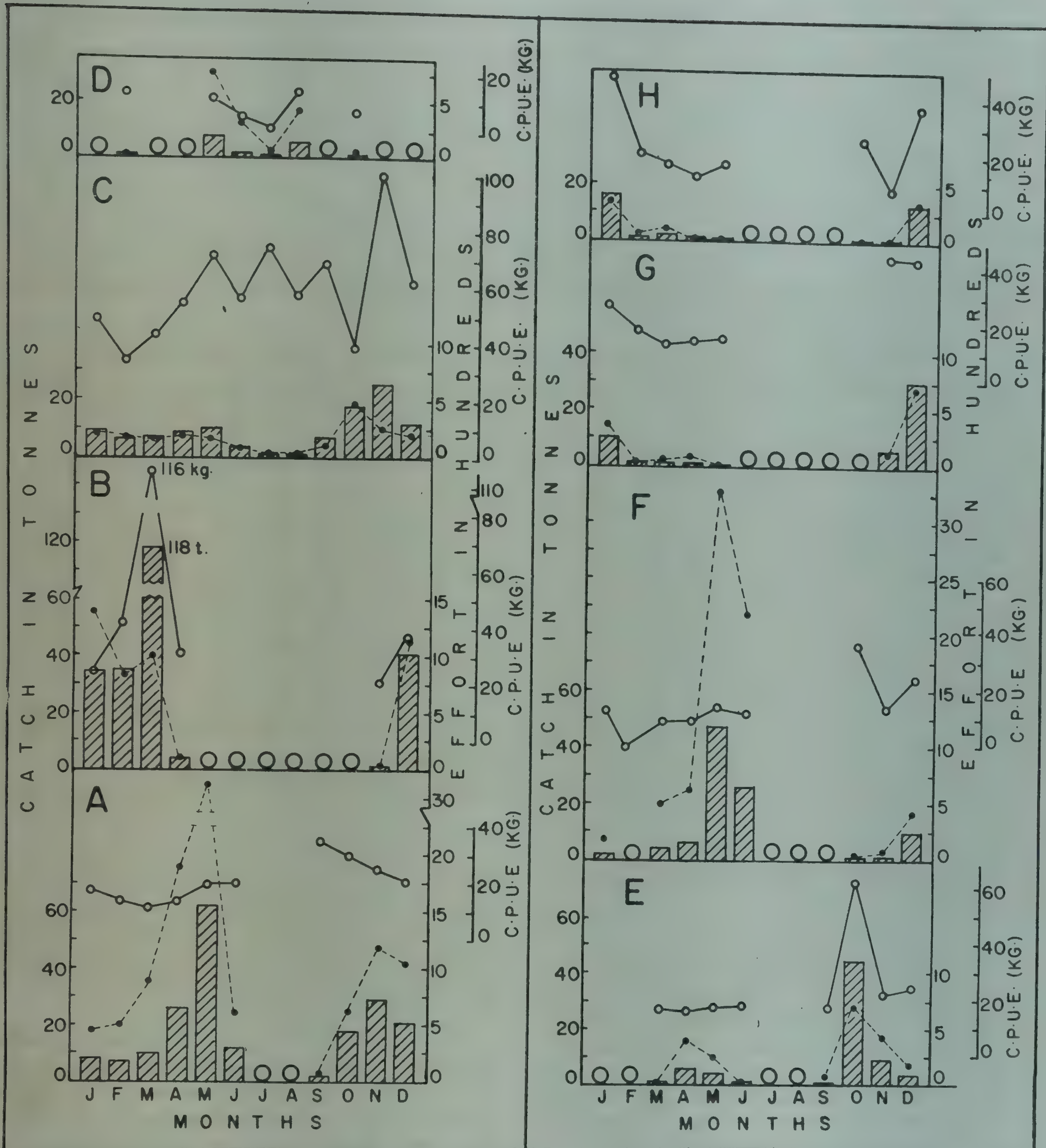

Fig. 3. The gearwise average monthly trends of catch, effort and catch per unit effort (C.P.U.E.) at Vizhinjam during 1968–1979. Open circle on the base line indicates that the gear was not operated during that month.

A. Chala vala, B. Katchal, C. Shore seine, D. Achil, E. Netholi vala, F. Konchu vala, G. Nandu vala, H. Kolachi vala.

of balistids during 1968–70, 1972, 1976 and 1977. The annual effort varied from 1,318 in 1970 to 6,894 in 1972 with the average for six years at 4,479 units. The year 1970 registered the minimum catch (25 tonnes) as well as C/E (19 kg), and 1972 registered the maximum catch (782.5 tonnes) as well as in C/E (113.5 kg).

Table 6. *Catch composition of important groups of fish (tonnes) during the years* 1968–1979 *in Katchal*

Groups	1968	1969	1970	1972*	1976	1977	Average	%	Rank
Balistids	153.2	61.6	25.0	470.0	197.1	172.1	179.8	77.5	1
Squids	—	—	—	312.5	—	—	52.1	22.5	2
Miscellaneous	—	—	—	—	0.2	—	0.1		
Total	153.2	61.6	25.0	782.5	197.3	172.1	232.0		

* Note: The gear was not operated during 1971, 1973–'75 and 1978–1979.

Table 7. *Catch composition of important groups of fish (tonnes) during the years* 1968–1979 *in shore seine.*

Groups	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	Average	%	Rank
Leiognathids	30.9	57.9	17.9	8.9	3.6	7.6	20.1	5.1	7.8	3.4	20.2	19.6	16.9	15.3	1
Caranx	25.6	34.1	22.8	16.7	7.0	4.5	23.7	10.8	6.5	2.4	8.9	11.9	14.6	13.2	2
Stolephorus	15.8	23.4	7.1	13.8	5.9	18.7	24.1	2.3	18.2	6.0	22.1	6.3	13.6	12.4	3
Lesser sardines	34.2	11.6	1.4	38.2	2.9	7.0	6.6	1.8	4.1	1.4	5.7	20.8	11.3	10.3	4
Decapterus	1.4	21.7	0.6	33.7	4.9	—	8.0	2.0	1.1	0.6	7.3	2.0	7.0	6.3	5
Dussumieria	15.9	8.9	4.6	8.3	0.2	—	8.0	0.5	3.1	0.3	4.3	0.6	4.6	4.1	6
Mackerel	4.8	10.0	6.8	7.4	3.8	2.8	2.2	2.2	2.6	1.1	6.5	0.7	4.2	3.8	7
Sphyraena	—	7.0	0.2	2.8	0.1	13.6	0.1	—	0.4	3.4	17.2	2.4	3.9	3.6	8
Squids	21.4	10.0	0.8	—	1.0	—	—	1.5	0.5	0.9	8.9	0.9	3.8	3.5	9
Sciaenids	2.4	10.2	1.1	0.2	0.1	—	0.7	—	i.3	—	14.7	9.2	3.3	3.0	10
Cat fish	—	—	—	0.3	—	—	—	—	—	—	—	34.4	2.9	2.6	11
Juvenile fishes	—	6.9	—	2.2	1.7	2.9	7.1	0.8	2.7	1.7	0.9	0.2	2.3	2.1	12
Puffer fish	—	—	—	—	—	15.7	11.0	—	—	—	—	—	2.2	2.0	13
Euthynnus	4.5	4.4	2.6	0.2	11.4	—	0.8	0.6	0.2	—	0.1	—	2.1	1.9	14
Perch-like fishes	2.7	1.4	0.8	6.8	1.2	—	2.1	0.7	0.5	0.2	3.6	4.1	2.0	1.8	15
Megalaspis	9.6	2.8	1.2	1.5	0.1	1.2	2.8	—	0.2	0.8	3.2	0.2	2.0	1.8	16
Miscellaneous	11.5	16.0	25.2	9.8	20.2	4.7	9.1	8.0	9.1	6.3	25.0	18.0	13.6	12.3	—
Total	180.7	226.3	93.1	150.8	64.1	78.7	126.4	36.3	58.3	28.5	148.6	131.3	110.3		

The average annual catch and C/E were at 232 tonnes and 51.8 kg respectively. The relative efficiency of the gear was 0.83.

'Katchal' is operated during January–April and November–December with intense operations during January–March and December (December to March) when 72% and 25% of the annual effort is expended, landing 80% and 18% respectively of the annual catch with the monthly C/E ranges of 25.0–0 116.3 kg and 36.3 kg respectively during the two seasons, March being the best season for this fishery (Fig. 3B).

Balistids or file fish accounting for about 78% form the dominant catch in Katchal followed by squids (22%). Only rarely stray catches of other fishes are obtained by this gear (Table 6).

Shore seine: Shore seine was operated in all the years and the annual effort ranged between 622 units in 1972 and 6,286 in 1968, with the average at 1,962 units per year. The total catch ranged from 28.5 tonnes in 1977 to 226.3 tonnes in 1969 with the average at 110.3 tonnes. The C/E ranged between 28.8 kg in 1968 and 115.9 kg in 1971 with the average at 56.2 kg. The relative efficiency of shore seine was 0.90.

The shore seine is operated almost throughout the year, and the operations are intense during January–April and October–December when 36% and 47% of the annual effort is expended landing 29% and 51% of the annual catch with the monthly C/E ranges of 34.1 kg–54.9 kg and 38.5 kg–100.0 kg respectively during the two seasons (Fig. 3C).

Carangids accounting for 21.3% form the dominant catch followed by *Leiognathids* (15.3%), *Stolephorus* (12.4%), sardines (10.3%), others being *Dussumieria,* mackerel, *Sphyraena,* squids, Sciaenids, cat fish, Tetraodontids, perches and early juveniles of fishes, squids and prawns (Table 7).

Table 8. *Catch composition of important groups of fish (in tonnes) during the years 1968–1979 in Netholi vala*

Groups	1968	1969	1970	1971	1972	1973	1974	1976*	1977	1968	1979	Aver-age	%	Rank
Stolephorus	32.5	52.4	38.1	56.9	29.0	153.3	29.0	24.8	3.1	75.1	15.0	70.1	99.7	1
Sardines	—	—	2.0	—	—	—	—	—	—	—	—	0.2	—	2
Total	32.5	52.4	40.1	56.9	29.0	153.3	29.0	24.8	3.1	75.1	15.0	70.3		

* Note: Netholi vala was not operated during 1975.

Table 9. *Catch composition of important groups of fish (tonnes) during the years 1975–1979 in Konchu vala*

Groups	1975*	1976	1977	1978	1979	Average	%	Rank
Prawns	6.0	14.3	8.2	116.3	16.5	32.2	33.5	1
Mackerel	—	—	2.0	15.7	37.5	11.0	11.5	2
Sciaenids	—	—	0.8	36.4	17.7	11.0	11.4	3
Caranx sp.	0.2	—	1.9	35.0	15.5	10.5	10.9	4
Lactarius	4.7	—	0.9	37.0	5.0	9.5	9.9	5
Leiognathids	—	—	1.9	9.7	5.8	3.5	3.6	6
Therapon	—	—	—	8.2	4.1	2.5	2.6	7
Flat fish	—	—	—	1.5	8.7	2.0	2.1	8
Cat fish	—	—	—	6.9	1.5	1.7	1.7	9
Rays	—	—	—	6.0	1.8	1.6	1.6	10
Chirocentrus	—	—	—	4.2	3.2	1.5	1.5	11
Miscellaneous	—	—	5.6	25.2	15.6	9.3	9.6	
Total	10.9	14.3	21.3	302.1	132.9	96.3		

* Note: Konchu vala operation was started from 1975

Netholi vala: Except for the year 1975, Netholi vala was operated in all the years from 1968 to 1979. At an average of 2,064 units per year, the yearly effort varied between 206 units in 1977 and 5,259 units in 1972. The average annual catch was 70.2 tonnes with a very wide range of 3.1 tonnes in 1977 and 290.2 tonnes in 1972. The C/E ranged from 13.2 kg in 1968 to 76.4 kg in 1978, with the annual average at 34.0 kg. The relative efficiency of this gear was 0.5.

Netholi vala has two seasons of operation, one during March–June and the other during September–October, with intense operations during April–May and October–December, when 32% and 63% of the annual effort is expended accounting for 15% and 82% respectively of the annual catch with the monthly C/E ranges of 15.7 kg-18.1 kg and 22.3 kg-62.0 kg respectively during the two seasons, October being the best season for the Netholi vala fishery (Fig. 3 E).

As the local name of the gear implies, *Stolephorus* constitutes almost the entire catch of this gear. Occasionally, however, juveniles of sardines and of other fishes are also caught in this net (Table 8).

Konchu vala: The Konchu vala was operated from 1975 onwards. On an average 7,248 units were operated per year. The effort ranged from 1,292 units in 1977 to 18,072 in 1978. The annual catch varied between 10.9 tonnes in 1975 and 302.1 tonnes in 1978 with the average at 96.3 tonnes. The minimum C/E of 6.4 kg and maximum of 16.7 kg were observed in 1976 and 1978 respectively with the average at 13.3 kg. The relative efficiency of this gear was 0.21.

The 'Konchu vala' was operated during March–June and October–January but the operations were intense during April–June period, when 84% of the annual effort is expended, accounting for 81% of the annual catch with the monthly C/E range of 9.3 kg–14.3 kg, highest yield being obtained in May (Fig. 3 F).

Prawns form the dominant catch (33.6%) followed by mackerel (11.5%), Sciaenids (11.4%), carangids

(10.9%), *Lactarius* (9.9%) and others: leiognathids, theraponids, flat fishes, cat fish and rays (Table 9).

Nandu vala: During the period 1968–69 this gear was in operation only for six years: from 1971 to 1974, 1978 and 1979. The annual effort ranged from 167 units in 1972 to 3,603 units in 1973, with the average at 1,445 units. The average annual catch was 50 tonnes with the annual variation of 2.8 tonnes in 1972 and 169.6 tonnes in 1973. The annual C/E ranged between 16.6 kg in 1972 and 47.1 kg in 1973 with the average at 34.6 kg. The relative efficiency of the gear was 0.55.

'Nandu vala' is operated during January–May and November–December (November–May), with intense operations during January and November–December (November–January) when 85% of the annual effort is expended, landing 94% of the annual catch with the monthly C/E ranging from 27.3 kg to 44.3 kg (Fig. 3G).

Crabs mainly *Portunus* spp. accounting for 59.4% form the dominant catch in this gear, followed by mackerel (7.5%), skates and rays (7.5%), nemipterids (7.1%); others being carangids, balistids, *Thenus orientalis* and *Sphyraena* (Table 10).

Kolachi vala: The gear was operated from 1971 onwards except during 1974. The annual effort ranged between 111 units in 1971 and 2,189 units in 1972 with the annual average of 900 units. The annual catch also showed wide variation, being 1.3 tonnes in 1971 and 94.5 tonnes in 1973, with the average at 32.6 tonnes. The annual C/E ranged between 9.8 kg in 1975 and 51.3 kg in 1973 with the average at 36.3 kg. The relative efficiency of this gear was 0.58.

'Kolachi vala' is operated during January–March and December (December–March) with intense operations during January and December (December–January) when 76% of the annual effort is expended, landing 88% of the annual catch with the monthly C/E ranging between 36.5 kg. and 47.7 kg (Fig. 3H).

The net as its local name implies, is designed mainly to catch half-beaks. Thus *Hemirhamphus* spp. accounts for the bulk (89.7%) of the catch by this net, followed by flying fish (Exocoetidae) 9.4%, and a few other stray catches (Table 11).

Achil: This gear was operated only during 1972 to 1974 and 1977, when the effort varied between 861 units in 1972 and 2,820 units in 1973, with the annual average at 1,723 units. The fish catch ranged from 5.9 tonnes in 1972 to 23.2 tonnes in 1977. with the annual average at 17.8 tonnes. The annual C/E ranged from 6.9 kg in 1972 to 22.1 kg in 1974, with the average at 10.3 kg. The relative efficiency of Achil was 0.16.

Achil appears to have no specific season of operation. However, over the four years when it was employed, its active operation was noticed during May–June and August when about 87% of the annual effort was expended landing 93% of the annual catch with the C/E ranging between 5.4 kg and 14.3 kg (Fig. 3D).

Table 10. *Catch composition of important groups of fish (tonnes) during the years 1971–1979 in Nandu vala (Bottom set gill net).*

Groups	1971*	1972	1973	1974	1978*	1979	Average	%	Rank
Crabs	3.9	0.2	—	—	3.0	1.5	29.7	59.4	1
Mackerel	—	—	—	—	7.6	15.0	3.8	7.5	2
Nemipterus	0.3	—	—	20.9	—	—	3.5	7.1	3
Rays	5.7	1.6	—	—	6.3	4.0	2.9	5.9	4
Carangids	—	—	—	—	6.3	7.4	2.3	4.5	5
Balistids	12.4	—	—	—	—	—	2.1	4.1	6
Thenus orientalis	—	0.9	169.6	—	4.5	2.5	1.3	2.6	7
Skates	—	—	—	—	3.4	1.3	0.8	1.6	8
Sphyraena	—	—	—	—	2.6	1.3	0.6	1.3	9
Miscellaneous	4.3	0.1	—	—	7.2	6.9	3.1	6.0	
Total	26.6	2.8	169.6	20.9	40.9	39.9	50.1		

*Note: Nandu vala (Bottom set gill net) operation was started from 1971. The net, however, was not operated from 1975 to 1977.

Table 11. *Catch composition of important groups of fish (tonnes) during the year 1971–1979 in Kolachi vala*

Groups	1971*	1972	1973	1975	1976	1977	1978	1979	Average	%	Rank
Hemirhamphus	1.3	58.5	94.3	1.5	10.5	6.6	50.1	11.3	29.3	89.7	1
Cypsilurus	—	24.4	—	—	—	—	—	—	3.0	9.4	2
Miscellaneous	—	—	0.2	—	0.1	—	1.0	1.1	0.3	0.9	
Total	1.3	82.9	94.5	1.5	10.6	6.6	51.1	12.4	32.6		

* Note: Kolachi vala operation was started from 1971. This gear, however, was not operated during 1974.

Table 12. *Catch composition of important groups of fish (tonnes) during the years 1972–1977 in Achil.*

Groups	1972*	1973	1974	1977	Average	%	Rank
Dussumieria	2.8	11.2	1.5	2.2	4.4	24.9	1
Lesser sardines	3.1	9.4	1.5	—	3.5	19.8	2
Caranx	—	—	6.2	3.2	2.5	13.2	3
Decapterus	—	—	3.2	4.7	2.0	11.1	4
Trichiurids	—	—	7.0	—	1.7	9.8	5
Mackerel	—	—	0.9	3.7	1.2	6.5	6
Nemipterus	—	—	1.1	2.9	1.0	5.5	7
Sarda orientalis	—	—	—	3.3	0.8	4.6	8
Saurida	—	—	—	2.1	0.5	3.0	9
Miscellaneous	—	—	—	1.0	0.2	1.5	
Total	5.9	20.6	21.4	23.1	17.8		

* Note: Achil operations were started from 1972. The gear, however, was not operated during 1975–76 and 1978–79.

Small sized fish are generally hooked by this gear. Thus *Dussumieria* spp. and *Sardinella* spp. accounting for 25% and 20% respectively form the dominant catch of Achil, followed by carangids (24.3%), *Trichiurus* (9.8%), mackerel (6.5%), *Neimpterus* (5.5%); others being tunas, *Saurida* and a few other stray catches (Table 12).

Species composition

From the foregoing account, it could be noticed that a large variety of fishes support the fishery at Vizhinjam, and the landings of each gear have a characteristic species composition of fishes. In fact, some of the gear are designed to catch particular groups of fish (Table 13). The seasonal trends in the catches of important groups of fish are given in the following account (Fig. 4).

The ribbon-fish (Family Trichiuridae) fishery comprising mainly of *Trichiurus lepturus* rank foremost among the different fisheries occurring off Vizhinjam. The average annual landings of ribbon-fish was 1,021 tonnes, forming about 22.6% of the total fish landings. Most of the catch (97%) is landed by boat seine at an annual catch rate of 29.5 kg per net and during June–October (99%) with peak landings in July (Fig. 4A).

Carangids are the next important group with the average annual landings at 601 tonnes accounting for about 13.3% of the total fish landings. *Decapterus dayi* and *Megalaspis cordyla* with the average annual landings at 159 tonnes and 152 tonnes, accounting for 26% and 25% respectively of the carangid catches are the two important single species fisheries of the carangids. The rest of the catches comprises mainly species of *Carangoides, Caranx, Selar* and *Chorinemus (Scomberoides)* followed by stray catches of the species of *Alectis, Alepes, Atropus, Atule, Elagatis, Gnathanodon, Selaroides, Trachinotus, Uraspis* and *Ulua*. Carangids are landed almost throughout the year with good catches during July (12%) and September–November (43%). The fishery season for *Decapterus dayi* is May–November with peak landings during July and September. *Megalaspis cordyla* on the other hand has two distinct fishery seasons, a major one during October–November

Table 13. *Percentage contribution by different gears to the landings of important groups of fish based on average annual landings during the period* 1968–1979.

Sl. No.	Groups	Hook and line	Boat seine	Drift net	Shore seine	Bottom set gill net	Kachal	Netholi vala	Konchu vala	Achil	Kolachi vala	Chala vala	Annual average catch (In tonnes)
1.	Sharks	51.7	0.1	48.0	—	0.1	—	—	0.1	—	—	—	70.8
2.	Rays	37.5	18.1	34.8	3.2	4.5	—	—	1.9	—	—	—	32.9
3.	Oil sardine	—	87.2	0.3	1.2	—	—	—	—	—	—	11.3	33.0
4.	Lesser sardine	0.2	23.2	0.2	5.2	0.1	—	0.1	0.2	0.5	—	70.3	219.4
5.	*Dussumieria*	4.7	73.6	—	5.8	—	—	—	0.5	1.9	—	13.5	78.9
6.	*Stolephorus*	—	70.3	—	5.2	—	—	24.3	—	—	—	0.2	264.0
7.	*Saurida*	85.1	7.3	2.5	0.2	0.2	—	—	0.6	0.5	—	3.6	39.7
8.	Cat fish	49.0	37.7	11.1	1.7	0.1	—	—	0.4	—	—	—	173.8
9.	*Tylosurus*	52.3	2.4	44.6	0.5	—	—	—	—	—	0.2	—	28.6
10.	*Sphyraena*	15.3	34.5	35.9	8.2	0.7	—	—	0.8	—	—	4.6	47.6
11.	*Lactarius*	1.1	80.7	1.8	1.1	—	—	—	11.3	—	—	4.0	35.2
12.	*Megalaspis*	56.0	4.4	38.1	1.3	0.1	—	—	0.1	—	—	—	152.3
13.	*Decapterus*	31.9	61.6	0.9	4.4	—	—	—	0.1	0.4	—	0.7	158.5
14.	Other carangids	38.2	27.8	26.1	5.0	0.3	—	—	1.5	0.3	—	0.8	290.3
15.	*Coryphaena*	94.0	—	5.8	0.1	0.1	—	—	—	—	—	—	31.6
16.	Lutianids	69.6	6.7	23.2	0.1	0.4	—	—	—	—	—	—	47.0
17.	*Nemipterus*	82.4	13.9	1.5	0.1	1.6	—	—	0.1	0.3	—	0.1	114.1
18.	Leiognathids	—	84.7	—	9.0	—	—	—	0.8	—	—	5.5	187.5
19.	Sciaenids	5.6	80.3	1.5	5.0	—	—	—	6.9	—	—	0.7	66.4
20.	Lethrinids	70.0	0.3	29.1	0.3	0.2	—	—	0.1	—	—	—	61.9
21.	*Upeneus*	15.3	77.0	0.9	3.0	—	—	—	0.7	—	—	3.1	51.2
22.	Trichiurids	2.3	97.1	0.3	0.1	—	—	—	—	0.1	—	0.1	1,021.3
23.	Mackerel	9.6	39.2	36.2	5.6	2.5	—	—	6.1	0.5	—	0.2	75.1
24.	*Auxis*	9.1	—	90.7	0.1	0.1	—	—	—	—	—	—	144.5
25.	*Euthynnus*	35.0	0.1	64.0	0.9	—	—	—	—	—	—	—	221.0
26.	Seer fish	6.3	1.8	90.9	1.0	—	—	—	—	—	—	—	111.6
27.	*Istiophorus*	54.9	—	45.1	—	—	—	—	—	—	—	—	32.2
28.	Balistids	42.4	0.7	0.1	—	0.7	56.1	—	—	—	—	—	160.3
29.	*Acetes*	—	98.6	—	1.4	—	—	—	—	—	—	—	48.6
30.	Squids	8.7	69.5	—	2.8	—	19.0	—	—	—	—	—	137.0
31.	Cuttle fish	95.4	3.6	0.3	0.7	—	—	—	—	—	—	—	96.6
32.	Miscellaneous	19.6	32.7	22.6	4.2	5.6	—	—	5.8	0.1	7.4	1.9	291.8
	Average Total catch (In tonnes)	1,028.1	2,165.8	751.1	110.3	25.0	116.0	64.4	40.2	5.9	21.7	196.2	4,524.7
	%	22.7	47.9	16.6	2.4	0.6	2.6	1.4	0.9	0.1	0.5	4.3	

landing about 50% of the annual catch and a minor one during March–May accounting for about 25% of the annual catch. In some years, good catches are also obtained in December (Fig. 4B and C). One or the other species of the 'Other carangids' are caught almost throughout the year in good quantities with peak landings during September–October, accounting for 30% of their annual landings (Fig. 4D). Bulk of the catches of *Decapterus dayi* is landed by boat seine (62%) and hook and line (32%), whereas those of *Megalaspis cordyla* is landed by hook and line (56%) and drift net (38%). The 'other carangids' are mainly caught by hook and line (38%), boat seine (28%) and drift net (26%).

The tunas *Euthynnus affinis* and *Auxis thazard*, with their relative contributions at about 60% and 40% respectively together contribute annually to about 365 tonnes accounting for about 8.1% of the total fish landings, and rank third, next to ribbon-fish and carangids. Two principal gear namely drift net (64%) and hook and line (35%) contribute to the bulk of *Euthynnus* landings, while *Auxis thazard* is mainly caught in drift net (90%), the hook and line accounting for about 9% of the catch. Both these genera are landed almost throughout the year with two periods of peak landings, the major one during March–May and the minor one during October–November (Fig. 4 E and F). Stray catches of *Sarda orientalis, Thynnus albacares, Kishionella tonggol, Katsuwonus pelamis* and *Auxis rochei* are met with in the tuna landings.

Anchovies rank fourth in the fisheries of the area with the average annual landings at 272 tonnes, accounting for about 6% of the total fish landings. Bulk of the catch (97%) is formed by *Stolephorus* and the rest by *Thryssa*. The fishery for the former has two principal seasons namely, June–July and September–October accounting for about 29% and 48% respectively of their annual catch (Fig. 4G). Boat seine lands bulk (70%) followed by gill net (Netholi vala)-24%, shore seine-5% and the rest by other gear. Three species namely *Stolephorus devisi* (47%), *S. bataviensis* (31%) and *S. buccaneeri* (14%) comprise the bulk of *Stolephorus* catch, and the rest by *S. indicus, S. andhraensis, S. commersonii, S. macrops* and *S. heterolobus*. *Thryssa* is landed mainly by boat seine and Chala vala. *T. setirostris* and *T. mystax* together account for 90% of the *Thryssa* catch.

Sardines (genus *Sardinella)* accounting for about 5.6% of the total fish landings are the next important group. About 252 tonnes of this fish are landed annually. Of this, oil sardines *(S. longiceps)* accounts for only about 13% of the catch, whereas the lesser sardines account for the bulk (87%) of the catch. About half the lesser sardine catch is constituted by *S. gibbosa,* followed by *S. sirm* (24%), *S. dayi* (13%), *S. fimbriata* (6%) and the rest by a few other species. Fishery season for oil sardine lasts from May to October with good landings in June and August. The fishery for lesser sardines, on the other hand, lasts for almost throughout the year with two periods of good catches namely April–May and October–November accounting for 30% and 22% respectively of their annual landings (Fig. 4H).

Squids and cuttle fish with their relative composition at 58% and 42% respectively and the combined average annual catch at 234 tonnes rank sixth in the fisheries of the area accounting for 5.1% of the total fish landings. Bulk (70%) of the squid catch is landed by boat seine followed by Katchal (19%) and hook and line (9%), while most of the cuttle fish (95%) is caught by hook and line. Good fishery accounting for about 85% of the annual catch occurs during January, March and September for squids, and during January–February and September–November for cuttle fish as well (Fig. 4 I). *Loligo duvauceli* is the most important species of squids caught in the area with stray catches of *Doryteuthis singhalensis;* the most important species of cuttle fish is *Sepia pharaonis* with stray catches of *S. aculeata, S. elliptica, Sepioteuthis lessoniana* and *Sepiella inermis*.

Silver bellies (Family Leiognathidae) comprising the genera *Leiognathus, Secutor* and *Gazza* and contributing about 187 tonnes annually account for about 4% of the total fish landings. *Leiognathus bindus* and *Secutor insidiator* are the two important species of silver bellies of the area. The other species met with are *Leiognathus daura, L. dussumieri, L. brevirostris, L. equulus, L. lineolatus, L. splendens, L. leuciscus, Secutor reconius* and *Gazza minutus*. Bulk (85%) of the leiognathid catch is landed by boat seine, followed by shore seine (9%), Chala vala (5%) and the rest by other gear. Though the fish is landed almost throughout the year, nearly 90% of the catches are landed during April–October with peak landings in June (Fig. 4K).

Cat fish catches amount to about 174 tonnes annually and account for 3.8% of the total fish landings. Hook and lines land about half the annual catch followed by boat seine (38%), drift net (11%), and other gear. Though the fish is landed almost throughout the year, bulk of the annual catch is landed during July (18%) and September–November (50%) (Fig. 4L). Important

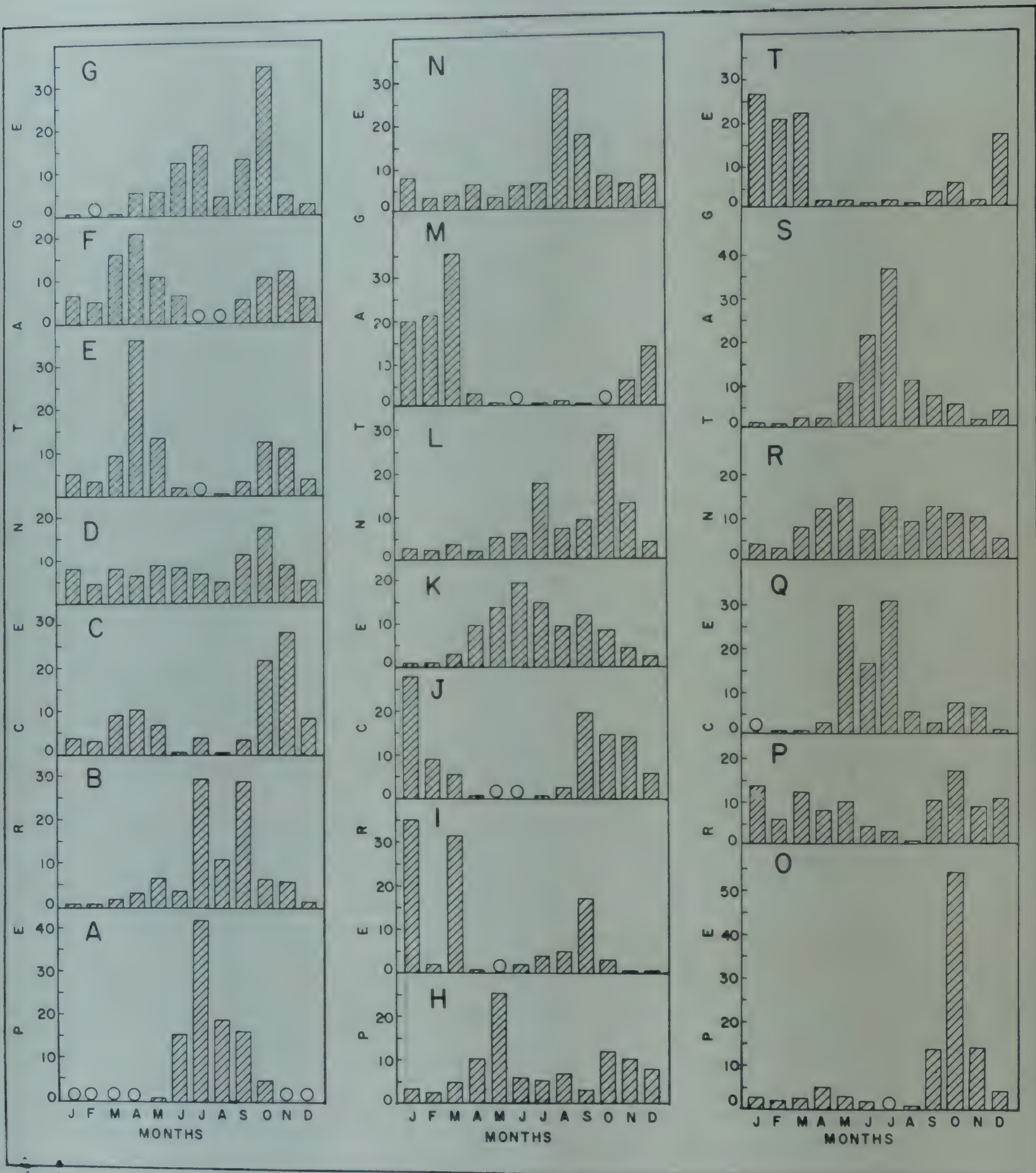

Fig. 4. The seasonal trends in the catches of important groups of fishes at Vizhinjam during 1968–1979. Open circle on the base line indicates nil or negligible amount of catch during the corresponding month.

A. *Trichiurus*, B. *Decapterus*, C. *Megalaspis*, D. Other carangids, E. *Euthynnus*, F. *Auxis*, G. *Stolephorus*, H. Lesser sardines, I. Squids, J. Cuttle fish, K. Leiognathids, L. Cat fish, M. Balistids, N. Nemipterids, O, Seerfish, P. Sharks Q. *Dussumieria*, R. Mackerel, S. Sciaenids, T. Lethrinids.

species of cat fish caught are *Netuma thalassinus* and *Trachysurus dussumieri*.

File fish (Family Balistidae) contributing to 160 tonnes annually account for 3.5% of the total fish lan-

Fish landing activities and catches at Vizhinjam

dings. Bulk of this fish is caught by Katchal (56%)and hook and line (42%). Main fishery season which accounts for nearly 90% of the annual catch lasts from December to March, peak landings being obtained during March (Fig. 4M). *Odonus niger* is the dominant species of file fish of the area, with occasional good landings of *Sufflamen capistratus*. Other important species met with are *Pseudobalistes fuscus* and *Abalistes stellaris*.

The threadfin bream (Family Nemipteridae) contribute to about 114 tonnes accounting for 2.5% of the annual landings. *Nemipterus bleekeri, N. mesoprion, N. delagoae* and *N. japonicus* are the important species of the area. Bulk (82%) of the nemipterid catch is obtained by hook and line, followed by boat seine (14%), and other gear. The fish is landed throughout the year, main fishery season accounting for 45% of the annual catch occurs during August–September (Fig. 4N).

Seer fish (Family Scomberomoridae) landings amount to 112 tonnes and account for about 2.5% of the total annual fish landings. *Scomberomorus commersoni* forms the dominant species in the catches, followed by *S. lineolatus* and *S. guttatus*. Most of the catch of seer fish (about 90%) is landed by drift net, followed by hook and line (6%), and other gear. Main fishery season lasts from September to November when about 82% of the annual catch is landed (Fig.4 O).

Sharks and rays with their relative contribution at about 70% and 30% respectively contribute together to 104 tonnes annually accounting for about 2.3% of the total fish landings. Most of the shark catches (99.5%) are landed almost equally by hook and line and drift net (35%) and boat seine (18%). Though sharks and rays are landed throughout the year, September–March period accounts for about 70% of the annual catch (Fig. 4 P). Important species caught are *Loxodon macrorhinus, Scoliodon laticaudus* and *Carcharhinus limbatus* among sharks, *Gymnura poecilura, G. macrura, Himantura bleekeri, Amphotistius kuhli, Pastinachus sephen* and *Rhinoptera javanica* among the rays. Occasionally the skates, *Rhynchobatus djiddensis* and *Rhinobatus grannulatus* are also caught in the area.

Rainbow sardines (Family Dussumieridae) catches amount to about 79 tonnes and account for about 1.7% of the annual total fish landings. About 75% of the catch is landed by boat seine, followed by shore seine (5.8%), hook and line (4.7%) and other gear. Best fishing season lasts from May to July accounting for about 75% of its annual catch (Fig. 4 Q). *Dussumieria hasselti* and *D. acuta* occur in the catches.

Mackerel *(Rastrelliger kanagurta)* catches amount to about 75 tonnes annually and account for about 1.7% of the total fish landings. Boat seine and drift net are the two equally important gear for this fishery, together contributing to 75% of the annual catch, followed by hook and line (9.6%), Konchu vala (6.1%), shore seine (5.6%), Nandu vala (2.5%), and the rest by Achil and Chala vala. Good fishery occurs during April–May and July–November, when 25% and 52% respectively of the annual catch is landed (Fig. 4R).

Jew fish (Family Sciaenidae) with an annual catch of about 66 tonnes and pig-face bream (Family Lethrinidae) with an average annual catch of about 62 tonnes are the two other important groups of fish of this area accounting for 1.5% and 1.4% of the total fish landings. Most of the sciaenid catch (80%) is obtained by boat seine, whereas the lethrinids are mainly caught by hook and line (70%) and drift net (29%). Good fishery season occurs during May–August accounting for about 78% of the annual landings for sciaenids, and during December–March accounting for about 84% of the annual landings for lethrinids (Fig. 4S). Important sciaenids caught are *Sciaena dussumieri, Johnius maculatus* and *J. osseus* and those of lethrinids are *Lethrinus ornatus, L. mahsenoides, L. reticulatus* and *Lethrinella miniata*.

Seven more groups of fish and *Acetes* each accounting for about 1% of the total fish landings could be considered of some fishery importance in the Vizhinjam area. They are *Upeneus, Lactarius* and *Acetes* which are caught mainly in boat seine; *Sphyraena* caught mainly in boat seine and drift net; *Lutianids, Istiophorus gladius, Coryphaena* and *Tylosurus* which are caught mainly by hook and line and drift net; and *Saurida* caught mainly by hook and line. Though prawns and half-beaks do not constitute a sizable catch in the Vizhinjam area, they are caught in good quantities in certain months.

General remarks

Out of the eleven types of gear employed at present in the traditional fishing at Vizhinjam, three gears namely boat seine, hook and line and drift net are the principal gears used, accounting for the major share of about 87% of the total fish landings. These three and the other gears together comb the waters off Vizhinjam for harvesting the fishery resources generally upto a distance of about 8–10 km, and upto a depth of

about 40–50 metres. Surface and mid-water pelagic fishes therefore form the mainstay of the traditional fisheries at present. Very little is known about the demersal fishery resources of the inshore fishing grounds as also of the fishery resources of the offshore waters. Hence, fisheries developmental activities in the area could be initiated by introducing the modern versions of the three principal traditional fishing gear of the area. Thus mid-water trawling, long lining and drift gill netting together with bottom trawling seem to offer good prospects for increased exploitation of the fishery resources of this area.

MECHANISATION OF INDIGENOUS CRAFTS WITH OUTBOARD MOTORS IN TAMIL NADU - AN IMPACT STUDY*

Mechanisation of fishing in India during the last few decades has resulted in the enhancement of catches and thereby better income for the fishermen. As a part of this general process of mechanisation, indigenous crafts are being motorised with outboard engines in different maritime states of India including Tamil Nadu, leading to promising results. In this context, a study relating to the extent of mechanisation of catamarans in the districts of Kanyakumari and Thirunelveli of Tamil Nadu and their economy was carried out and a brief account is given below.

About 80 out of 1,848 catamarans in the region from Neerodi to Enayam Puthenthurai in Kanyakumari district and 10 out of 935 catamarans in Uvari and Periyathalai villages in Thirunelveli district are fitted with outboard motors (Table 1). All these units are fitted with Yamaha engines (model 8 B.K., 7 H.P.) costing about Rs. 10,300 during August–December period of 1981. The catamarans have 4 to 5 logs measuring about 25 feet length and cost about Rs. 5,000 per catamaran.

The number of catamarans fitted with outboard motors is very much less in Thirunelveli district and maximum in Vallavilai and Marthandanthurai of Kanyakumari district. The catamarans wih outboard motors in relation to total catamarans available in the villages are 8 per cent in Vallavilai, 12 per cent in Marthandanthurai and less than 3.5 per cent in other fishing centres.

In Thirunelveli district there does not seem to be much impact due to the motorisation of the catamarans. The motorised catamarans in Uvari and Periyathalai villages in this district operated for about a period of four months from October '81 to January '82. There is not much difference in the total catches of motorised and non-motorised catamarans in this area. It is reported by the fishermen here that when the wind is

Table 1. *Details of number of catamarans fitted with outboard engines in Kanyakumari-Thirunelveli coast*

Districts	Fishing centre/village	Total catamarans	No. of catamarans fitted with outboard motors
Kanyakumari	Neerodi	175	6
–do–	Vallavilai	385	30
–do–	Marthandanthurai	202	25
–do–	Thoothoor and Eraviputhenthurai	489	7
–do–	Enayam Puthenthurai	597	12
Thirunelveli	Uvari	505	7
–do–	Periyathalai	430	3

*Prepared by R. Sathiadhas,

favourable the non-mechanised catamarans are also able to move by using sails as fast as the catamarans fitted with outboard motors. Hence the fishermen of this area keep outboard motors in their units as reserve and utilise the same whenever the wind is unfavourable The gears used by the fishermen of this area are drift nets and hooks and lines. The composition of catch is *Scomberomorus* sp, *Chirocentrus, Lactarius, Sciaena* and *Arius*.

In Kanyakumari region, the gear used in motorised units is hooks and lines with the aid of artificial baits. Three to five persons go for fishing in each unit. Normally they leave the shore between 3 and 4 a.m. and return to the shore between 6 and 8 p.m. The fishing season for these mechanised catamarans extend from November to March. They mainly go to fish for cuttle fishes, *Sepia* spp, which realise very good price due to export market. Along with *Sepia* spp. they also get good quantities of tunas, serranids, lutjanids, perches and balistids. The non-motorised catamarans of this area operate throughout the year using hooks and lines with scoop nets. The man power employed for this operation is 2 in each unit. They leave the shore between 5 and 6 a.m. and return between 2 and 4p.m. the duration of actual fishing being only 3 to 5 horus. The speciewise average catch per trip both for motorised and non-motorised catamarans with price per kg to the landing centre is given in Table 2.

Table 2. *Average catch per catamaran trip and price rate at the landing centres in Kanyakumari region (November* 1981-*March* 1982)

Sl. No.	Name of fish/ species	Average catch per trip per catamaran unit (kg) Motorised	Non-motorised	Price rate at the landing centre Rs/kg
1.	*Sepia* sp	15	1	17.00
2.	*Pristipomoides types*	18	—	4.00
3.	*Epinephelus tauvina*	7	—	4.00
4.	*Cephalopholis sonnerati*	5	1	4.00
5.	*Odonus niger*	12	5	1.50
6.	*Sufflamen capistratus*	3	2	1.50
7.	Lutjanids	5	—	4.00
8.	*Coryphaena*	5	1	4.00
9.	Tuna	5	—	5.00
10.	*Caranx* sp.	3	1	5.00
11.	*Scomberomorus sp*	—	4	8.00
12.	*Rachycentron sp.*	—	1	5.00
13.	*Tylosurus* spp.	—	1	4.00
14.	*Lethrinus* spp.	3	1	4.00
15.	Misc.	10	3	2.00

The gross returns by the motorised catamarans range from Rs. 100 to 2,000 per trip, averaging to Rs. 500. Each crew is given an allowance of Rs. 5 per trip in addition to his share. The income after deducting the fuel expenditure and allowance to the crew members is shared 50 per cent each among the owner of the unit and the crew members. The share received by the crew members is equally divided among themselves. The number of actual fishing days ranged from 20 to 25 days per month during this period and the average share received by each crew member works out to Rs. 37 per trip.

The fuel requirement per trip for the mechanised units is about 20 to 30 litres of kerosene and 1.5 to 3 litres of petrol. The fishermen used to take with them additional kerosene in barrels. During November 81-March '82 procurement of kerosene for their units became a great problem. There was no special allotments of kerosene for these units and the fishermen had to rely mostly on private traders who charged about Rs. 3 per litre which is 50 per cent higher than the official price. Repairing and maintenance charges of the outboard motors amount to about Rs. 250 per month. The average operational expenditure which includes fuel, repairing and maintenance of the engine and allowance to the crew members would be Rs. 130 per trip.

The gross fishing income of a non-motorised catamaran operating with hooks and lines average about Rs. 90 per trip in Kanyakumari region. This income is divided into 3 equal shares—two shares to the crew and one to the owner of the unit.

Due to motorisation employment opportunity is doubled since the motorised catamaran requires 3 to 5 persons instead of only 2 for the non-motorised units. The increased mobility and the easy accessibility of the fishing ground for the motorised catamarans resulted in higher gross returns of almost 6 times as compared to the returns of catamarans without outboard engine. The wage earners of the motorised units earn about 30 per cent higher than those of the non-motorised units.

There is no marketing problem for the disposal of the fish. More than 80% of the catches that are landed in the late hours are utilised for drying and

curing, the rest preserved in ice and disposed off in the morning. It is learnt that no subsidy or institutional loan is issued to the fishermen for the purchase of outboard motors. Most of the fishermen report that they have recovered more than 70 per cent of the capital investment during the short span of operation for five months.

The fishermen in Kanyakumari district operated these units in the respective centres only from November '81 to March '82 and after-wards all the units have migrated to Sakthikulangara area of Kerala coast for fishing. Their migration to the Kerala coast is mainly due to the roughness of sea and decline in the catch of *Sepia* spp. which fetches high prices. They report that their mechanised catamarans will return to the respective centres during November 1982 when the cuttle fish fishery starts.

Due to lack of facilities for the repairing and servicing of the outboard motors in this area, the fishermen have to go all the way to Vizhinjam even for minor repair works. It is desirable to have more stations started where spare parts and servicing facilities are readily available especially keeping in view of the expected increase in the number of motorised catamarans. As already mentioned, fishermen have been experiencing difficulties in procuring kerosene oil at reasonable price and it is suggested that the State Government may take necessary steps for continuous supply of kerosene oil to the fishermen operating motorised catamarans.

The help rendered in the collection of data by S/Shri I.P. Ebenezer and N. Retnaswamy, Technical Assistants, Kanyakumari Field Centre of C.M.F.R.I. is acknowledged.

NEWS – INDIA AND OVERSEAS

Bureau of fish genetics in India

A bureau of fish genetics resources is being set up in India by the Central Marine Fisheries Research Institute (CMFRI). The bureau will collect and classify information on the more important organisms found in Indian waters, particularly those which may be useful in aquaculture. It will also lay down conditions for the preservation of fish genetic material to ensure maximum efficiency at fish farms. Another function of the bureau will be to serve as a contact liaison agency for the exchange of such material with international agencies.

The bureau will operate from three centres. One in the fresh water aquacultural research and training centre of the Central Inland Fisheries Research Institute (CIFRI) at Dhauli, Orissa which would devote attention mainly to fresh water fish. Another unit will be located at CIFRI's Research Centre at Kakdeep in West Bengal and connected with brackish water species. The third Centre will be at Cochin to study marine species.

Success in crab rearing

The mud crab *Scylla serrata,* the largest and most expensive variety of crab in South East Asia has been successfully reared by Professor Hon-Cheng Chen at the National Taiwan University Laboratory. He succeeded in hatching the eggs of the gravid females and rearing the larvae to the juvenile stages. Under his supervision the Taiwan Fish Culture Station produced large numbers of young crabs.

As a result of the studies several small commercial crab hatcheries have sprouted, some of which producing 1,00,000 megalops a month. Berried female crabs are taken from the sea and put in shallow concrete ponds to hatch the eggs which in turn develop into zoea. Fed on rotifers, these become megalops in 15 to 18 days and then in turn fed on brine shrimp grow to early juveniles within 7 days. At this stage they are sold to crab farmers.

Fish Farming International 8 (4): December 1981

Mussels for arthritis

Research in New Zealand has shown encouraging results to prove that mussels might relieve thousands of arthritis patients. An extract from their native green mussel *Perna canaliculus* is found to be 60 per cent successful in relieving rheumatoid arthritis symptoms. It is also effective in 50 per cent of the cases of osteoarthritis. The medicinal extract of the mussel is known as Seatone.

Among 16 species of mussel found in New Zealand only two species of mussels are cultured by using the raft as well as longline methods in addition to the wild stocks available in these waters. The cultured green mussels are increasingly used for the medicinal purpose.

In Indian waters also there are two species of mussels which are commercially important, the green and the brown. The latter *Perna indica* has a limited distribution in the southern most part of the peninsular India and the former *Perna viridis* is distributed in other areas. It is possible that any one of these species might prove to have the medicinal values as the green mussel of New Zealand.

Fish Farming International 9 (1): March 1982

Compiled and prepared by M. J. George & G. Subbaraju.
Published by Dr. M. J. George, Senior Scientist on behalf of the Director, Central Marine Fisheries Research Institute, Cochin-682 018 and printed at PAICO, Cochin-31

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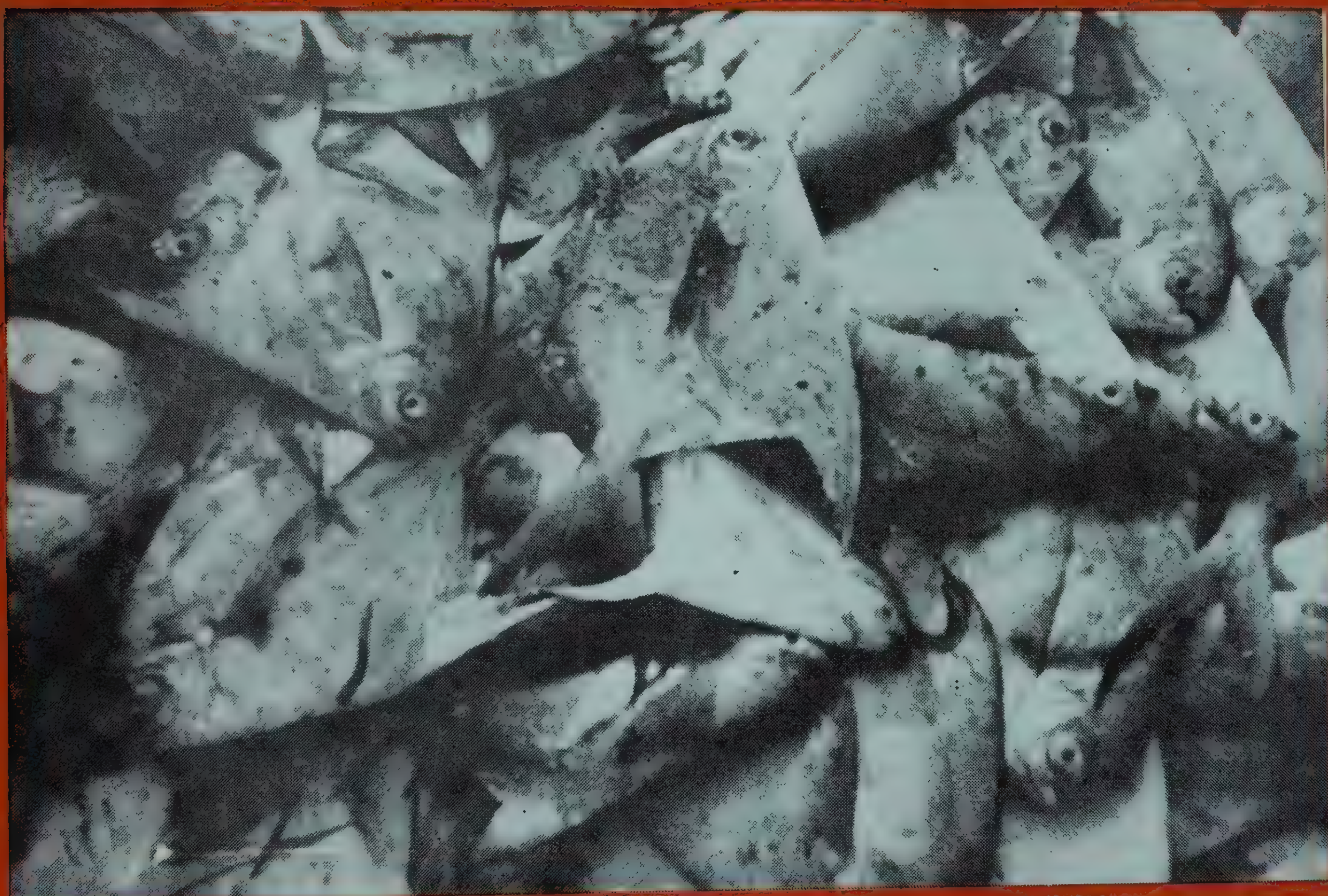

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Abbreviation — *Mar. Fish. Infor. Serv. T & E Ser.*, No. 39: 1982.

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Cover photo: Catch of white pomfret from Palk Bay.

PAIR TRAWLING STRIKES GOOD GROUNDS FOR WHITE POMFRET IN THE PALK BAY, TAMIL NADU

N. Gopalakrishna Pillai and R. Sathiadhas, Central Marine Fisheries Research Institute, Cochin.

Introduction

Gear technologists of the FAO Project on development of small-scale fisheries under the Bay of Bengal Programme (BOBP), funded by the Sweedish International Development Authority (SIDA) established in 1980 at Madras have designed and fabricated a two-boat, high opening bottom trawl for pair trawling operations to be taken up in different sectors of the coastal area of the Bay of Bengal. Of the several zones where they introduced this method, as part of a phased programme, Palk Bay zone with Mandapam, Pamban and Rameswaram as bases of operation was chosen for experiments during 1980-81. In addition to their trials, practical demonstrations of the two-boat trawling were also given to local fishermen which provided necessary stimulus for the mechanised boat owners to take up pair trawling as a new fishing venture in this part of the country. During the course of commercial-scale operation the mechanised boat owners met with a certain amount of success during the earlier part of their fishing. In early February 1982 a few units each operating from Mandapam, Pamban and Rameswaram landed heavy catches, especially of pomfrets. This generated great interest among the boat owners resulting in intense fishing effort by pair trawling which yielded unusually large catches of fishes mainly rainbow sardines and pomfrets. Pomfrets being in demand as quality table fishes and the landings, as was witnessed during these operations, quite unusual in this region, attention was paid to gather the details and the results of the operations during February to April 1982 are presented.

The authors wish to express their sincere thanks to Dr. E. G. Silas, Director for encouragement and S/Shri T. Jacob, G. Venkataraman and S. Mahadevan for their suggestions on improvement in the manuscript. They are also grateful to Skipper Shri P. V. Ramamurthy of F A O / Bay of Bengal Programme for making available valuable information and sketches of the gear.

Area of operation

The areas where the pair trawling was conducted are shown in Fig. 1. Fishing was restricted to within 79° 10′—79° 30′E longitude and 9° 20′—9° 40′N latitude in the Palk Bay north of Mandapam in Tamil Nadu. The sea bottom in this area is mostly muddy and the depth of operation ranged between 10 to 12 m.

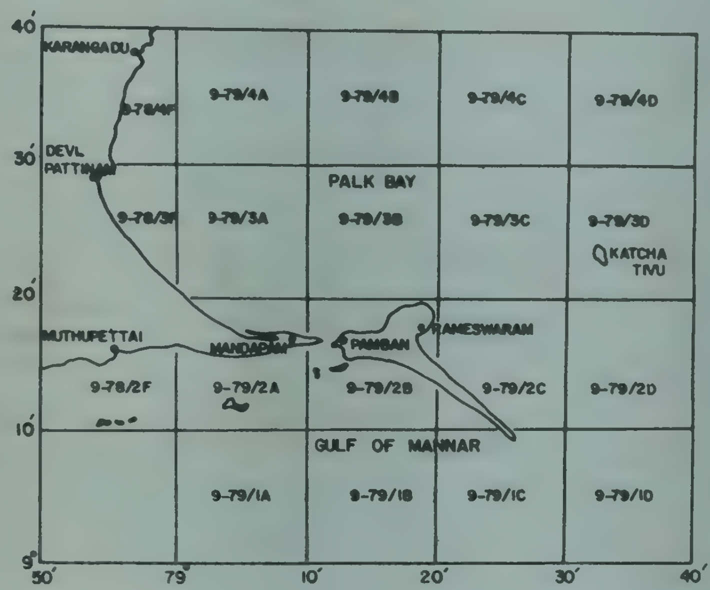

Fig. 1. Map showing the areas of pair trawling operations conducted in Palk Bay off Rameswaram and Mandapam.

Craft and Gear

Mechanised boats (45 to 70 HP, diesel engines) of size ranging from 9.14 m to 9.75 m conducted pair trawling operations. The vessels have a free speed of 7 knots but at operation the trawling speed of the unit was maintained at 2.5 knots. The boats resorted only to daily fishing between 04 00 to 20 00 hrs due to lack of adequate fish hold facilities and limitations in working deck space.

The design of the two-boat, high opening bottom trawl (Fig. 2) introduced by the FAO is in the form of a conical bag consisting of wings 15.4 m, over hang 3 m, belly 23 m, throat 5 m and cod end 7.5 m with an overall head-rope length of 33 m. The size and specifications of nets used varied slightly according to the power of the engines of the boats. A diagrammatic sketch showing the operation of the net is given in

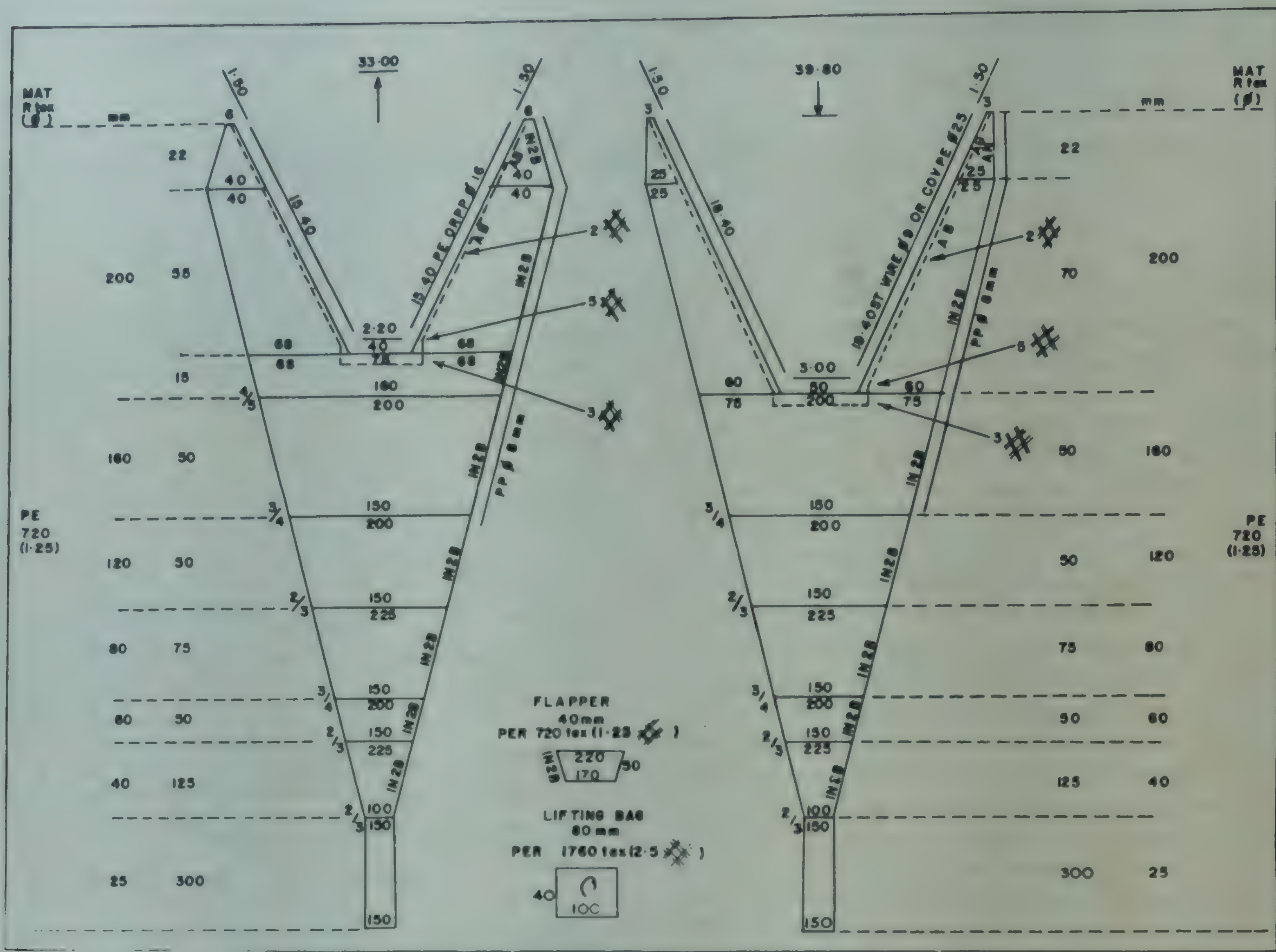

Fig. 2. The net design of the two-boat high opening bottom trawl.

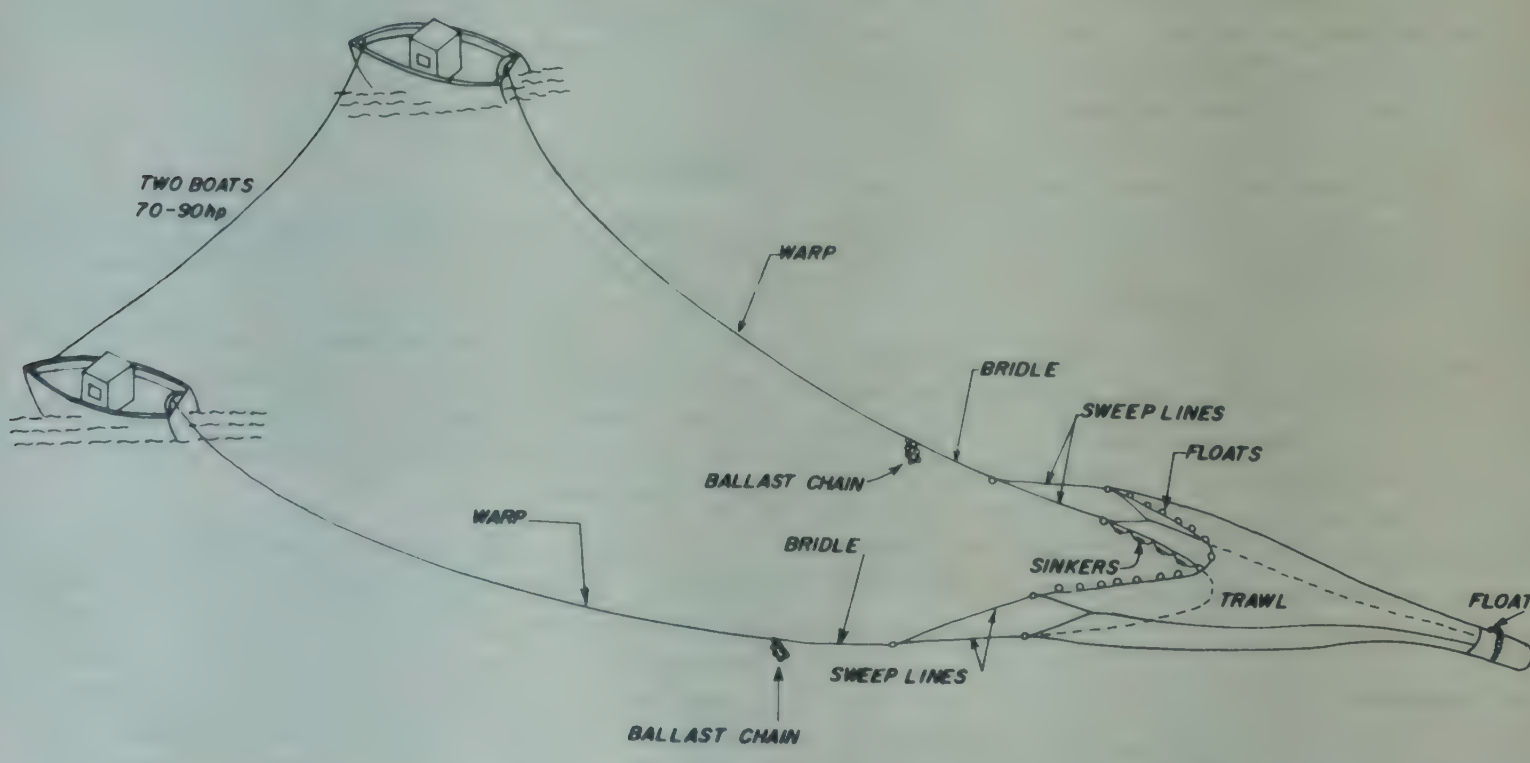

Fig. 3. The diagrammatic sketch showing the pair trawling operations.

Fig. 3. Two boats of identical size and horse power are employed.

Results of operation

The number of units operated and catch particulars of pair trawling conducted off Rameswaram and Mandapam during February to April 1982 are furnished in Table 1. While 384 units conducted trawling in February, it increased to 650 units in March. In April the number of units, however, declined. The total estimated landings of fishes during these three months was 1,166.7 tonnes and the catch per unit effort 1,093.4 kg. The maximum yield of 761.26 tonnes and yield rate of 1.17 tonnes is observed in March (Fig. 4).

Catch composition

The percentage composition of the dominant groups of fishes (Fig. 5) shows that pomfrets and rainbow sardines were landed more or less in equal proportions. *Dussumieria* spp. (mostly *Dussumieria acuta* Valenciennes) constituted 29.95% of the total catch closely followed by silver pomfret, *Pampus argenteus* (29.66%). Stray catches of black pomfret, *Parastromateus niger* (Bloch) were also present. Sciaenids and cat fishes formed 17.55% and 9.32% respectively. Other important groups landed were silver bellies (5.75%), rays (4.79%) and miscellaneous fishes, mainly *Pellona* spp., *Hilsa* spp., *Ilisha* spp., Carangids and lesser sardines other than rainbow sardines (2.98%).

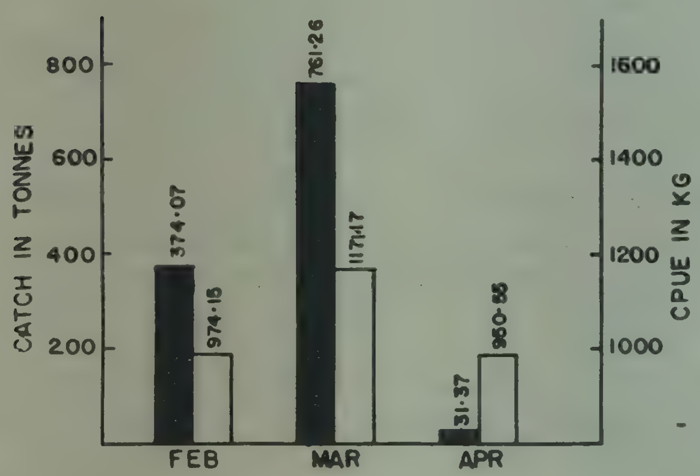

Fig. 4. Total catch (■) and catch per unit effort (□) of all categories of fishes landed.

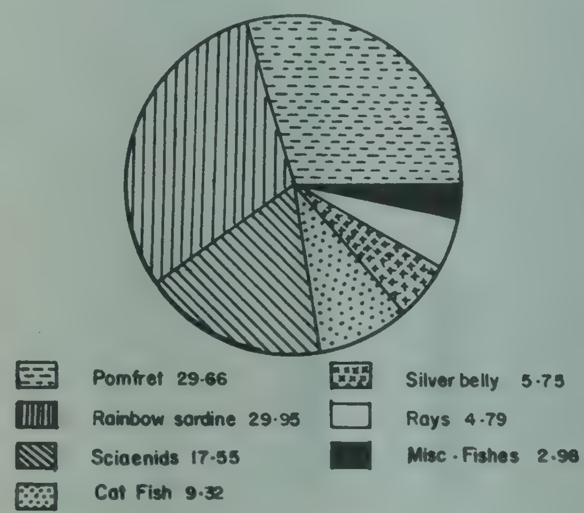

Fig. 5. Percentage composition of dominant groups of fishes landed by pair trawling.

Table 1. *Total catch in tonnes and catch per unit effort in kg (in parenthesis) of dominant groups of fishes landed by pair trawling operations during February to April 1982.*

Months	No. of units operated	Pomfrets	Rainbow sardines	Sciaenids	Catfishes	Silver bellies	Rays	Misc. fishes	Total catches
February	384	113.13 (294.62)	114.58 (298.37)	76.59 (199.45)	9.12 (23.76)	13.93 (36.28)	28.70 (74.74)	18.02 (46.94)	374.07 (974.15)
March	650	226.88 (349.05)	225.24 (346.53)	124.20 (191.07)	95.05 (146.22)	48.12 (74.02)	27.29 (41.98)	14.48 (22.28)	761.26 (1,171.17)
April	33	6.06 (183.85)	9.67 (292.93)	3.97 (120.21)	4.57 (138.39)	5.00 (151.52)	- -	2.10 (63.64)	31.37 (950.55)
Total	1,067	346.07 (324.35)	349.49 (327.54)	204.76 (191.89)	108.74 (101.91)	67.05 (62.83)	55.99 (52.47)	34.60 (32.43)	1,166.70 (1,093.45)

Observations on silver pomfret

Catch trends

As can be seen from Table 1 and Fig. 5 silver pomfret forms one of the two predominant constituents. During the three months of pair trawling operations an estimated 346.07 tonnes of pomfrets were landed by 1,067 units with a catch per unit effort of 324.35 kg. Pomfrets occurred in February with fairly good catch rate of 294.62 kg. The maximum catch (226.88 tonnes) and catch rate (349.05 kg) was in the month of March. The fishing gradually came down to a catch rate of 183.85 kg and abruptly ended by the middle of April (Fig. 6).

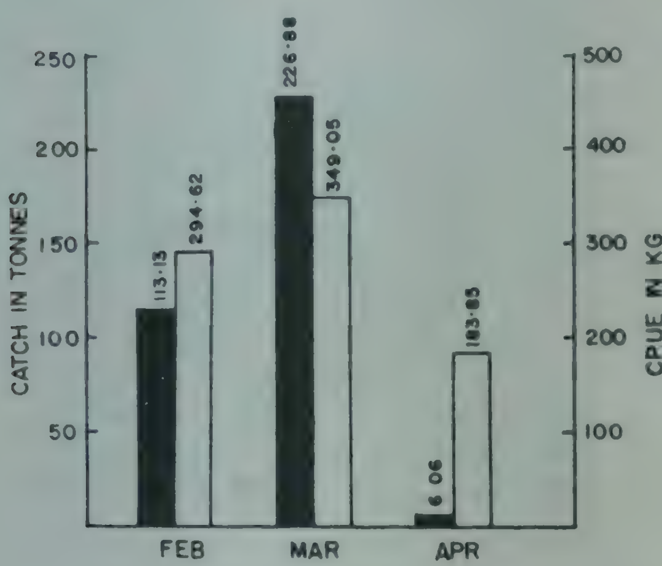

Fig. 6. Total catch (■) and catch per unit effort (□) of pomfrets.

Area-wise catch particulars are not available, making it difficult to assess the relative abundance of pomfrets in the ground. However, through information gathered from fishermen the sub-areas 9-79/3C and 9-79/4C (Fig. 1) appear to be more productive.

Biological Observations

Data on length of the pomfrets were collected for the month of March. The catches consisted of fish ranging from 145 to 280 mm size with the dominant size group at 235 mm. Examination of the stomach contents collected from representative samples indicated that the fishes have been feeding mostly on crustaceans apart from larval bivalves, gastropods and polychaetes. Most of the specimens examined were in the II, III and IV stages of maturity.

Marketing

During the peak period of the fishery, in the latter half of March, marketing of pomfrets was a problem faced by the fishermen. About 10 percent of the pomfrets caught weighed each 350 g and above, about 80 percent weighed in the range of 200 to 250 g each and the rest less than 200 g. The demand by the small traders for fresh fish in the nearby markets was far less compared to the aggregate supply. Hence bulk quantities of pomfrets were iced and sent to Madras, Trichy, Madurai, Coimbatore, Pollachi, Pudukottai, Karaikudi, Paramakudi and parts of Kerala. The Tamilnadu Fisheries Development Corporation (TNFDC) also came into the picture, procuring pomfrets from Rameswaram centre for sale at Madras. However, the number of commission agents and wholesale merchants involved in fish trade was comparatively less and the aggregate market demand was fully controlled by them, resulting in a lack of demand for pomfrets during the peak period. Thus the price declined from Rs 10/- per kg during first week of February to Rs 6/- per kg during the first half of March and Rs 4/- per kg during the latter half of March, when there were maximum catches. The fishermen

Table 2. *Average price per kg for different varieties of fish at the landing centre in Rameswaram and Mandapam (February-March 1982)*

Sl. No.	Name of fish/species	Average Price Rs/kg
1.	Pomfrets	6.00
2.	Rainbow sardine	1.00
3.	Catfish	1.50
4.	Rays	0.80
5.	*Thryssa* sp	0.75
6.	Silver bellies	0.60
7.	*Saurida* sp	1.25
8.	*Sardinella* spp	0.90
9.	*Upeneus* sp	1.75
10.	Sciaenids	1.50
11.	*Chirocentrus* sp	2.50
12.	*Scomberomorus* spp	7.00
13.	*Drepane punctata*	1.00
14.	*Lactarius lactarius*	3.00
15.	*Hilsa* sp	0.40
16.	*Trichiurus* sp	1.25
17.	Polynemus	1.25
18.	Cephalopods	4.00
19.	*Ilisha* sp	1.25
20.	*Cynoglossus* sp	2.00
21.	*Sillago* sp	1.25
22.	Misc.	1.00

could not even get enough ice to preserve the unsold pomfrets during the peak period. The average prices per kg received by the fishermen at the landing centre for different varieties of fish are given in Table 2. The lesser sardines, silverbellies and other clupeids were salted and sun dried to meet the demands of the lucrative interior markets in Kerala and Tamil Nadu.

Employment

The man power employed in pair trawling during the peak period of March 1982 was about 500 in Mandapam and Rameswaram region. Those engaged in pair trawling were previously doing the usual trawl fishing. The change in fishing pattern during this period was mainly due to comparatively lesser returns in trawl fishing and high profitability of pair trawling. About 200 persons got additional employment in the subsidiary activities such as handling, transportation, drying and curing during the peak period.

Operational cost and returns

The number of persons engaged in fishing with the high opening bottom trawl nets ranged from 10 to 12 per unit. The payment of wages for the fishermen were in two ways, one is fixed wages given to the crew irrespective of the catch, and the other the sharing system wherein 35 to 40 per cent of the net income is divided among them in addition to the daily allowance of Rs 5/- to Rs 15/- per head. Detailed information regarding the operational costs such as diesel and lubricating oil expenditure, wages to the crew members and shore costs were collected. The average operational expenditure per trip of pair trawlers, following the fixed wage system is given in table 3 and it works out to about Rs 1,200/- excluding the interest for capital investment, depreciation, insurance and repairing and maintenance charges.

Based on the average species-wise catch per trip (Table 1) and the price per kg at the landing centre (Table 2) the gross income has been computed to Rs 2,800/- per trip. However, during the first week of April all the pair trawlers shifted again to trawl fishing as the catch rate of pomfrets declined and as the prawn fishery became more profitable.

Remarks

The introduction of mechanised fishing in the east coast over the past twenty years has brought out changes not only in the pattern of fishing but also in the industry as well in many areas. Palk Bay is one such zone, which has been changing in recent years as far as the pattern of fishing is concerned. This area is well known for its rich traditional fisheries like lesser sardines, silver bellies, seer fish, perches and squids among others. In recent years commercial scale trawling operations in this area by mechanised boats have established an important prawn fishing industry in and around Rameswaram Island. The present fishing effort by pair trawling, a new venture for the fishermen of this area, is yet another diversification in fishing. This would definitely indicate future possibilities of large scale seasonal fishery for pomfrets from these waters. The trend of these operations and the landings in the coming years will be watched with special interest.

In this context it may be mentioned that pomfrets constitute only 3% of the total marine fishing landings in India (*Mar. Fish. Infor. Serv. T & E Ser.* No. 32, 1981). In the east coast, Tamil Nadu ranks only third

Table 3. *Average operational expenditure per trip of pair trawlers*

	Item	Qty or Nos.	Rate (Rs)	Amount (Rs)
1.	Diesel	250 litres	3.18	795
2.	Lubricating oil	3 litres	14.00	42
3.	*Crew members*			
	a. Drivers	2 Nos.	35.00	70
	b. Asst. Drivers	2 "	30.00	60
	c. Luskers	8 "	20.00	160
4.	*Shore cost*			
	Assistants	4 "	15.00	60
5.	Misc.	–	–	15
	Total	–	–	1,202

in importance for pomfret landings. A fishery comprising of *Pampus argenteus*, *Parastromateus niger* and *Pampus chinensis* has been known from the strip of Coromandel coast stretching north of Vedaranyam up to Arcatthurai by the traditional gear. In Rameswaram Island and in the vicinity sporadic catches have been reported in the past from gill nets and bottom set nets. Trawl fishing in recent years are also known to bring in stray catches of pomfrets. Therefore such huge landings of pomfret as observed during February to April by pair trawling conducted off Rameswaram, Pamban and Mandapam are quite a significant feature and this is the first time that such heavy landings have been reported here. It would seem that this valuable resource was not being exploited all these years because of lack of a suitable fishing gear to capture the shoals which might have been migrating to this area seasonally. It remains to be seen whether in the coming years pair trawling operations during the particular period would bring in pomfrets in such large quantities as to make it an additional regular seasonal fishery.

At a future time if such seasonal fishery of quality table fishes is established, measures should be taken to ensure reasonable prices for the fishermen. It is suggested that the Tamil Nadu Fisheries Development Corporation should either take necessary steps to procure the entire quantity of quality fishes at times of unusual catch abundance or some other measure has to be evolved so that the middlemen would not exploit the fishermen.

The objective behind the introduction of two-boat trawling is to maximise catch. The high percentage occurrence of the lesser sardines in the catch is yet another pointer to the usefulness of the gear in exploiting different resources, especially in view of the fact that the popular shore-seine fishing which used to be one of the main tackles for landing them, has virtually disappeared following the intensification of mechanised fishing. With the intensive operation of the gear in coming years it is likely that more of these resources might be exploited, when proper utilisation of the same may also have to be considered.

SCIENTIFIC BASIS FOR THE MANAGEMENT OF PENAEID SHRIMP FISHERY*

Introduction

A global review of the penaeid shrimp fisheries of the world would show that some of the largest fisheries for shrimp is in the waters off Indonesia, Thailand, India and in the Gulf of Mexico. In fact in the past few years India has reached the top rank in world shrimp production of over 7,00,000 tonnes, of course partly contributed by non-penaeid shrimps also. In most of the areas of large shrimp fisheries the fishery consists of a combination of multispecies. This fact in addition to the unique life history and the resultant population characteristics renders the shrimp fishery management somewhat different in concept than the management of other fisheries. Apart from this the aportioning of the fishing effort between the artisanal or small scale fisheries and the mechanised, industrial fisheries always comes into conflict, creating further problems in proper management. The substantial quantities of small fish or trash fish coming in as by-catch in the trawl fisheries, discarded or utilised to a certain extent also causes concern.

Realising these global problems associated with shrimp fishery management, a Workshop on the Scientific Basis for the Management of Penaeid Shrimp was held at Key West, Florida, USA from 18 to 24 November 1981, sponsored by US Department of Commerce, National Marine Fisheries Service (NMFS), Gulf States Marine Fisheries Commission, Mississippi and Food and Agriculture Organisation of the United Nations (FAO). Dr. John A. Gulland, Chief, Marine Resources Service, Fishery Resources and Environment Division, FAO and Dr. Brian J. Rothschild, Professor, University of Maryland, Center for Environmental and Estuarine studies, Solomons, Maryland were the Co-convenors of the Workshop, which was attended by 45 participants from 15 countries. The author takes this opportunity to thank the authorities concerned for making it possible for him to participate in the Workshop and present the views

*Prepared by M. J. George.

concerning the shrimp fisheries of India, representing the country.

The discussions were based on a set of 35 papers, most of them reviewing the current situation in the major shrimp fishing countries, highlighting the problems and a few others examining particular situations. The deliberations considered the shrimp fishery and the identification of problems associated with management under various heads such as the biology of the shrimp and rate measurements, the data base, methods of analysis, multi-species problems, environmental aspects, management and future work. A brief review of the discussions on these topics and the recommendations for future work is attempted here.

The problems

Initial review of the shrimp fisheries of the different countries revealed that most shrimp fisheries throughout the world face similar problems. The stocks are fully exploited, with little opportunity of increasing total catches. At the same time fishing effort continues to increase, giving rise to serious economic or social problems, although the stocks themselves may be in no danger of overexploitation. Often due to lack of delineation of the ultimate management objective the scientists in many countries were not well prepared to provide the managers with the advice they require in proper management of shrimp fisheries. So the problems faced by the scientists in advising the managers to tackle their problems were discussed. Failure to identify the potential for changes in effective fishing effort and failure to identify economic signals are two important problems apart from problems in relations between stock and recruitment. The following scientific problems were also identified:—

1) The variations in stocks may mask trends, which would require observations made over extended periods.
2) Nursery areas are often separate from areas of adult stocks and may be specially vulnerable to environmental and human influences.
3) Age cannot be determined directly and therefore, techniques based on age of shrimp must be used cautiously.
4) The presence of distinct fisheries on different sizes of shrimp using various gears causes a number of scientific problems, particularly in calculating fishing effort, apart from the major problem for the fishery manager in terms of conflicts between the different sectors.
5) Most fisheries being based on multispecies exploited by multigears, techniques need to be developed for estimating population dynamics parameters and management in such setting.
6) Most of the models employed require the entry into the fishery to be sharp which is not the case in most shrimp fisheries, where the size of recruits varies considerably.
7) Some of the shrimp stocks exist in one or more coastal states or shared by neighbouring countries, involving concerted international cooperation for effective management.

These were discussed in the following sections and in the final section proposals were made for dealing with the problems.

The biology of shrimp and rate measurements

Growth, mortality, migration and stock identification and other biological topics were considered. Discussions concerning growth centred on evaluating the potential importance of variability in growth. While the method for extracting growth curves from length-frequency data presented by Daniel Pauly was found to be quite useful, the lack of knowledge of possible density-dependent growth was pointed out.

In the discussion on natural mortality the poor precision and accuracy among existing estimates was stressed. Published estimates being highly variable and showing outrageously high values, careful re-examination of techniques within the existing frame works of analysis should be considered. In migration and stock identification the necessity for recognition of the importance of stocks and migrations across international boundaries was mentioned.

The data base

Catch statistics: Total catch statistics are readily available for most of the shrimp fisheries, but there were cases where portions of the catches were not recorded at all, eg., from sport, subsistence, artisanal or brackish water fisheries. As complete catch data are very essential for many of the analytical approaches, omissions of potentially large components of the total catch could lead to biased pictures of the condition of stocks. Quantitative estimates of discards, both fishes as well as small shrimps are also important in this connection.

Effort data: It was noted that standardization of fishing effort is not often attempted. Several gears other than otter trawls being used in many fisheries, the total fishing effort for shrimp would need

to take into account all the gears in operation. For many applications, apart from consideration of fishing power, effort standardization would require a measure of catchability variations brought about by various factors such as physical aspects of gear performance, reaction of shrimp to gear, the large scale distribution of stock density and fishing effort etc. Decisions are required about the types of effort data and auxiliary information to be collected.

Methods of analysis

Production models: The production models require comparatively lesser data and are, therefore, widely used. The short life of shrimp meant that annual pairs of observation of catch and fishing effort are likely to match the equilibrium condition. One serious limitation in using production models is that of determining a suitable measure of effort.

These models usually showed a curved left-hand limb, sometimes a suggestion of a maximum, but very seldom a declining right-hand limb, for which various reasons were suggested. Yield-per-recruit analyses suggest a flat-topped curve so that if recruitment is not affected, a flat-topped curve of total yield may be more representative of reality than a parabola. Alternatively, declining total catches, and therefore even faster declines in catch per unit effort could cause the expansion of effort to stop for economic reasons before a declining right hand limb can be observed.

Age-or length-structured models: This type of models, based more or less directly on the yield-per-recruit calculations are essentially to study the effects of changes in the pattern of distribution of fishing mortality with age. Inevitably there were problems in estimation of certain parameters like natural mortality. One of the advantages of a length-structured analysis was that the critical parameter was usually M/K rather than M and it was suggested that M/K might be fairly constant within a species group.

Stochastic models: Stochastic modelling would be useful in understanding the relationship of parent stock size and environmental variation in establishing recruitment strength. Shrimp recruitment shows considerable variations from year to year which are not connected with any obvious changes in adult stock. The actual recruitment in any one particular year is determined very largely by environmental conditions in that year. So, the existence of environmental effects may bias the estimates of the stock-recruitment relation. If there are cases of low stock causing low recruitment, and fishing on these stocks is maintained at a high level, the risk of "recruitment overfishing" is very real. Thus the stock and recruitment relationship is quite important and stochastic models aim at working out equilibrium positions under a given stock-recruitment relation for various levels of fishing effort.

Multispecies problems

Two types of interactions have been considered. First is the problem of the incidental catch (by-catch) which is largely discarded (discards). The major part of the fish by-catch in several countries is discarded. The by-catch has three components, namely, (1) marketable fish, (2) juveniles of marketable species and (3) species for which no markets have been developed. The manager has 3 options regarding the by-catch, status quo, reduce the by-catch or increase utilisation of by-catch. Discussions centred around the ecological interactions between shrimp and the by-catch components. There is strong evidence that no reduction in shrimp production would occur if discards were removed from the system and utilised rather than deposited back into the system as dead animal biomass. The possibility of predation of shrimp by demersal fish affecting the shrimp biomass and the shrimp yield cannot be discounted. Further field, laboratory and analytical work needs to be oriented towards answering this question.

The second problem is caused by dependence of a fishery on several shrimp stocks, which may or may not be separated in space. There are two situations in this multispecies fisheries. In the first, the fishery depends on more than one stock occurring in different times because of behavioural differences. In the second case, a fishery may be dependent on two or more stocks harvested in the same operation. It is this case which gives fishery managers cause for concern. It is difficult to measure effective effort in order to make reliable stock assessments when fisheries are harvesting two or more species in the same place at the same time and this is one of the difficult problems facing the researcher in countries where such fishery exists.

Environmental aspects

Shrimps are very sensitive to the environment in which they live at all stages of their lives and this affects the operation of the fishery in many ways. Therefore, several aspects of the interaction between shrimp and the environment are important in the shrimp fisheries. In the discussions it was made clear that the important aspects to study are those which either lead to limit unfavourable changes (relations between destruction of nursery habitat and production) or at least predict them. The problem of the action of rainfall and river outflow on recruitment has

also been discussed bringing out relationship between nursery favourable areas and production. The conservation of the static habitat and necessity to strengthen measures aimed at reducing undue larval mortality by littoral management was stressed.

Concerning the correlation approach, the main difficulties lie in three different fields: 1) the use of the appropriate index for resuming a biological phenomenon (spawning, migration, recruitment, abundance), 2) the need to detect and avoid spurious correlations between phenomena varying with the same frequency and 3) the need to interpret the short term changes (noise) which in many cases may be more important than the long term condition (signal) itself. The problem of occurrence of natural or non-natural variations in production have to be understood in order to distinguish between error and real phenomena that have to be taken into consideration for management. A distinction between periodic and aperiodic changes is important because the former refers to naturally reversible phenomena while the latter most often refer to unreversible ones, leading to completely different problems and solutions in terms of management.

In the matter of predictive models it was felt that it was necessary that the important changes be detected and predicted in order to look for appropriate measures of alternation of the effects. In general these models usually fail to predict when they are confronted with the test of time and they are only able to make useful predictions at the extremes of the range of possible environmental values. It was pointed out that priority should be given to the development of "understanding model" before the mathematical ones are developed.

Management

Fisheries management in a broad sense may be defined as the manipulation of factors to achieve a goal from a stock of fish. More specifically this goal may be quantifiable in terms of societal benefits in the form of food production, value, employment or some combination thereof while maintaining the stock at some high level of sustainable production. The objective is usually to achieve an optimum balance between inputs and various outputs. As the fishery is developed and societal needs and values change, the management goals will change. The goals and values to be obtained from the fishery are determined by the society and it is the responsibility of a decision maker or fishery manager at some level to decide how to obtain these benefits from the fishery. If there is to be a scientific basis for the management programme the manager needs biological, economic and sociological information to assist him in the decision making process. The scientist should take care that he does not second guess what he believes to be the desires of the manager, but provides him a range of options. Simple bioeconomic models to predict the outcome of fishery management actions are needed to aid the fishery manager in the decision process.

The shrimp fisheries throughout the world are generally fully exploited and there is concern in many areas over the impact of the high level of exploitation of the stocks. The fisheries in some countries face economic problems resulting from the high fuel ccosts in shrimp production. Allocation among user groups, offshore, inshore, and artisanal fishermen is another problem. It was the consensus of the work group that because of the highly developed nature of the world's shrimp fisheries some form of management resulting in regulation is in order for all stocks. Stock maintenance is of increasing concern and the precarious position of some stocks may be masked by high economic yield. Various objectives such as adjustment of fishing mortality, fishing capacity, size at first harvest and allocation among user groups have been sought through a variety of management measures.

Discussions followed on the various management measures applicable, which could be broadly grouped under three categories. The first category aims at increasing the size at first harvest with due consideration given to natural mortality and other factors. The management measures coming under this include mesh size regulation, seasonal closures, area closures and minimum size limits. The second category would control the catch or reduce fishing mortality. Gear restrictions—type, size and number—effort manipulation, short fishing seasons, catch quotas, limited entry and limitation of capital are some of the methods considered under this category. The broad measures which may affect capacity of fishing, such as import duties and quotas which increase markets for domestically produced shrimp in an importing country and government subsidy for vessel construction, loan guarantees or fuel costs may also be included. The third method is habitat modification involving habitat enhancement, water management and pollution control.

To be effective a management measure must be enforceable as well as acceptable to most of the fishermen who are regulated. The cost and level of enforcement necessary to implement regulations should be considered at the onset. The fishery managers and scientists should monitor the condition of the fishery and be prepared to take prompt action to revise the management objectives and techniques if the

need arises.

Future work

In general the concerns being expressed on the various shrimp fisheries of the world are:

a) Most shrimp stocks are now being heavily fished;

b) Some shrimp stocks appear to have declined and the reasons for their decline are unclear;

c) The heavy fishing pressure in some fisheries may have resulted in a decrease in the abundance of spawning stocks to a level which is resulting in reduced recruitment;

d) In some areas there is a decline in the quality of the juvenile habitat;

e) The cost of operation of some segments of shrimp fisheries is increasing at a rate faster than the income generated;

f) There is conflict among user groups as to area and size at which shrimps are to be harvested. This can be at both the national and international level.

Within this frame work of concern, the workshop discussed future research needs and proposed that special attention be given to the following areas of research:

1. Stock and recruitment relationship:

   a) Definition of index of breeding stock abundance;

   b) Fecundity, with a view to estimating an index of age production;

   c) Definition of index of recruitment;

   d) Recruitment variability due to environmental factors.

2. Natural mortality:

   a) Comparative studies using data already available to obtain a greater understanding of the natural mortality of the different prawn types.

   b) Studies of the underlying causes of mortality—predation, physiological death, diseases.

   c) Further tagging studies with particular attention being given to the degree of tagging mortality.

   d) Life table studies and DeLury techniques.

3. Identification and standardization of effective fishing effort:

   a) Independent estimates of the stock, e.g. by fish locating techniques.

   b) Catchability studies—behaviour of the animals and fishing pattern of the fleet.

   c) Gear research—to estimate amount of fishing mortality generated by a particular gear type.

   d) Cohort analysis/Length composition analysis.

4. The habitat:

In summary, research should be undertaken on the life history of shrimp species in relation to the critical environmental influences. Also, a valuable contribution to the development of future research programs would be a global view of types and areas of inshore habitat in relation to shrimp abundance, and including information on habitat changes which have occurred.

5. Data base:

   a) Catch, catch composition and effort data (including by-catch species, discards and estimates of unreported catch);

   b) Number and type of fishing units;

   c) Number and type of personnel operating the units;

   d) Description of the fishing grounds, e.g. artisanal and industrial;

   e) Method of handling the production on the fishing units and in the factories;

   f) The market system;

   g) The value of the product at specified points of sale, and easily obtainable allied economic data;

   h) Significant changes which have taken place in the fishing units; personnel, grounds, marketing.

   i) Simple description of the environment, quantified where possible.

6. Data integration:

Greater attention for proper understanding of the method of collection and accuracy of the original data set. The data set will increase in complexity and value as research workers from the various disciplines start to work the data and make more specific their requirements for data collection. An appropriate technique of management information system should be adopted to assist in the integration of the data set, and this integration should include financial implications.

7. Use of models:

Concern was expressed that too much reliance should not be placed on the use of production models in terms of achieving optimum yield on a long term basis. Because of large variations in estimates of some of the parameters of shrimp stocks the applicability of the yield per recruit model is reduced. On the development of new models, adequate models were not available for a number of outstanding problems, like bio-economics, recruitment, decision making and allocation models. There is also a requirement for future work to include a model in conceptual form describing how the fishing fleet might respond to management options being considered.

8. Analysis of the system:

The workshop drew attention to the importance of scientific advice being presented in a manner which integrates the array of data available on the stock, the fishing units and the environment.

9. Ecological interactions:

Research is required on the ecological interactions of the fauna on the shrimp grounds to provide information on the likely consequences in terms of total yield of introducing gear changes such as shrimp separator trawl.

10. Socio economics:

a) Clarify management objectives for any particular fishery taking into account the existence of an inshore and an offshore fishery. In considering this subject consideration will need to be given to such matters as quantifying trade offs between net revenue, employment and individual income.

b) Determine costs and how these might be lowered by variations in the balance of elements of capital, manpower, energy, in the cost structure.

c) Determine the multiplier effect under various management options. For example, it is important to determine whether F for maximum employment is far to the right of F for maximum net revenue or F for optimum individual income. Such a study would assist in the resolution of conflicts between management objectives.

d) Provide information on the mobility in and out of the fishery of labour (especially in rural areas where there are cultural barriers), and of capital (access to loans, indebtedness and so on).

e) Provide information on fishermen's earnings.

f) Add to an understanding of the benefits of management options, such as the concept of property rights.

11. Priority and balance of research programmes

Methodology should be developed for determining criteria for the allocation of finance for research. While the management objectives will differ from one fishery to the other and from country to country, thus affecting the research priorities, the methodology will have general application.

BLACK KINGFISHES*

Rachycentron canadus (Linnaeus) (=*Elecate nigra*) popularly called black kingfish is the only representative of the family, Rachycentridae. It is also known as cobia, surgeon fish and lemonfish. It is reported to occur in all the warm seas except along the coasts off southern Australia in the Indo-Pacific area and the Pacific coast of North America and is rarely reported along the Japanese coast. These fishes are pelagic in nature and prefer largely the open seas, but are also recorded in shallow coral reefs and rocky shores. Occasionally they are reported to lurk near pilings, wrecks, buoys or other objects, stationary or floating.

These fishes possess an elongate sub-cylindrical body with a broad and depressed head (Fig. 1). The first dorsal fin is represented by 7–9 short strong isolated spines without any connecting membrane and are depressible into a groove. Caudal fin is rounded in juveniles whereas it changes to lunate form with a prolonged upper lobe in adults. The basic colour is dark brown and sometimes dark green along back, with two narrow black bands along the sides. Young specimens will have one or two sharply defined narrow silvery bands along the sides. These fishes were formerly grouped with remoras or sucker-fishes due to their external resemblances, but the osteological studies by Gill and Tate Regan established its close relation with Carangidae (Weber and de Beaufort 1931, *Fishes of the Indo-Australian Archipelago, VI Leiden*).

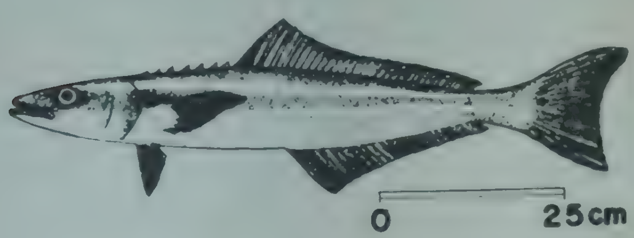

Fig. 1. The Black kingfish, *Rachycentron canadus* (Linnaeus)

The black kingfishes attain over 1.5 m in length with an average of 80–100 cm. Sometimes they travel in small shoals, but generally they appear solitarily. This slender and streamlined species with their fast swimming power are fine sporting fishes. Detailed studies on the biology of kingfishes are lacking. They mainly feed on crabs, squids and fishes.

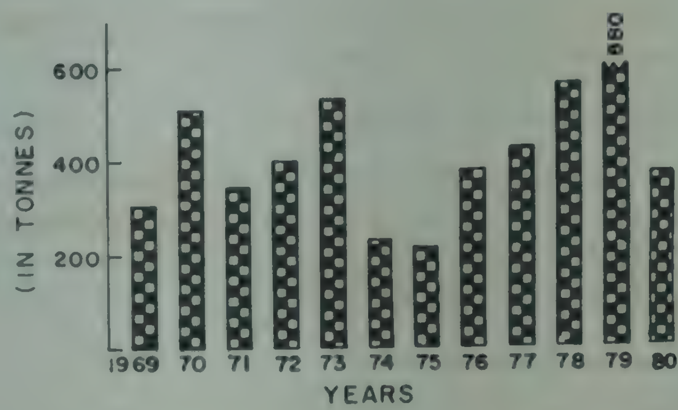

Fig. 2. Annual landings of black kingfishes in India from 1969 to 1980.

The landings of *R. canadus* along the Indian coast during the period, 1969–'80 show wide fluctuations. A steady increase in the catches were noted from 1975 onwards, the maximum landings being 880 tonnes recorded in 1979 (Fig. 2). With an estimated average catch of 438 tonnes per year Tamilnadu accounted for the maximum followed by Kerala. Being an excellent table fish they are in high demand and are marketed in fresh condition.

They are landed predominantly by drift gill nets, hand lines and troll lines mainly from the inshore waters along the Indian coast. In some countries they are also caught by artificial baits but generally taken on hooks with crabs or fishes as baits.

*Prepared by P. K. Mahadevan Pillai.

NEWS - INDIA AND OVERSEAS

Largest mass of krill find

Scientists who took part in the First International Biomass Experiment (FIBEX) in the Antarctic have reported the discovery of above 10 million tonnes of krill. Altogether 25 scientists and technicians from 11 countries were engaged in the two phases of the probe in which an international fleet participated from January to March 1981. The second part of the programme (SIBEX) is scheduled for 1983-84.

The survey focused on the Atlantic sector of the Antarctic and measured probably the largest ever concentration of sea creatures. Hydroacoustic methods have been mainly used for detecting swarms of krill. The enormous swarm was measured by this system over a period of three days north of Elephant Island and about 500 miles south east of Cape Horn. According to Dr. Osmund Holm-Hansen leader of the team of American scientists, this single mass contained enough krill to provide about 50 kg for each of the 226 million people in the United States!

Food uses have, however, still to be found for krill on this scale. One concern over krill as a potential human food has been an observed high fluoride content. But recent studies have shown that this is only in the shell. If the shells are quickly removed in processing and the body juices centrifuged off, the low fluoride content in the meat would be harmless. One more immediate use for krill is as food for salmon in marine farm projects.

FNI 20(6): June 1981

Fish attracting devices

The National Oceanic and Atmospheric Administration (NOAA) of the US Department of Commerce has recommended for funding a proposal to design, construct, deploy and monitor pelagic fish aggregating devices (FADs) in the southeast region. These devices will be placed in shallow, middle and deep waters in order to benefit both recreational and commercial fishermen and would include tyre reefs, islands of plastic canisters, mid water artificial reefs etc.

Fish aggregating devices have been successfully used in the Phillippines, Japan and Hawaii for the past several years to attract fish. Installations in the Pacific have proved quite beneficial to both commercial fishermen and recreational anglers. It is estimated that FADs in the State of Hawaii fishery is producing more than 500 tonnes of fish per year.

World Fishing 30(10): October 1981

Off-flavour in fish

Off-flavours, especially that of mud, have been reported in fish, both in cultured as well as wild fish. By taste and chemical analyses, geosmin has been identified as the primary compound responsible for this "muddy" or "musty" off-flavour. This is the predominant type of environment-related off-flavour in fish and has been found in cultured and wild fish all over the world. Recently other types of off-flavours like "metallic", "chemical", "grassy" etc have also been noticed in fish from intensively-fed ponds.

Aquaculture Magazine 7(6): Sept./Oct. 1981

Compiled and prepared by M. J. George, G. Subbaraju and S. K. Dharmaraja.
Published by Dr. M. J. George, Senior Scientist on behalf of the Director, Central Marine Fisheries Research Institute, Cochin-682018. Phototypeset and printed at PAICO, Cochin 31.

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Abbreviation — *Mar. Fish. Infor. Serv. T & E Ser., No.* 40: 1982.

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Cover photo: Monsoon leap at Valiathura.

FOCUS ON SMALL-SCALE FISHERIES SECTOR

ADVENTUROUS LAUNCHING OF CATAMARANS FOR MONSOON FISHERY AT VALIATHURA, TRIVANDRUM

G. Luther, P. A. Thomas, P. N. Radhakrishnan Nair and R. Bhaskaran Achari,
Vizhinjam Research Centre of C. M. F. R. Institute

The way the fishermen of Valiathura and adjacent fishing villages near Trivandrum launch out their catamarans into the sea during the period of southwest monsoon is an example of overcoming obstacles of nature through innovations and ingenuity. Fishing activity in many parts of the southwest coast lying between Cape Comorin and Quilon remains suspended often at many centres during June to August, the southwest monsoon period, mainly because the fishermen find it difficult to negotiate their catamarans through the breakers. The unfavourable height, direction and type of breakers that prevail along the coast during this period mainly cause this difficulty. On account of this the fishermen move to certain centres that afford favourable conditions for setting off their crafts into the sea. Centres like Colachal, Kollangode, Vizhinjam and Quilon have bays or barriers and hence are considered good for fishing operations during monsoon period. The fishermen of the area from Kovalam to Veli where the coast is rather straight, sandy and much exposed to the fury of monsoon waves, solve this problem by taking advantage of Valiathura pier for launching the craft safely into the sea.

The operations (Fig. 1–6)

The logs of catamarans are transported upto the terminus of the pier on trollies provided by the port authorities. Here, the logs are assembled and the fishing gear is loaded and fastened tight by the crew at the front part of the catamaran together with personal belongings of fishermen such as beetle leaves, beedis, etc. packed in polythene covers. A nylon rope is fastened to the front part of the catamaran with its free end tied to the fist or waist of one of the crew who gets ready to plunge into the sea. On noticing a major receeding wave with no incoming ones in sight, this fisherman jumps into the sea. The force of the receding wave takes him away from the pier. On noticing a similar powerful receding wave the catamaran also is pushed diagonally into the sea. The catamaran, like the fishermen, moves away from the pier, but its further movements are controlled by the first fisherman holding the rope. The other two fishermen forming the crew of the fishing unit likewise jump into the sea and all the three get into the craft as quick and fast as possible and manoeuvre it well beyond the wave crests.

Field enquiries made at Valiathura revealed that this practice was in vogue even in the olden days when a wooden pier existed at the place of the present pier. It is not known when this practice of fishing started at Valiathura. Usually fishermen below 40 years of age venture in this type of fishing activity.

The catamaran engaged in monsoon fishing is to be registered every season and a licence fee of Rs. 5 per fishing unit is levied at present by the port authorities. The system of licensing started in 1956 when the present pier was commissioned. During the period 1977–1981 the number of licences issued for such catamarans varied from 334 to 442 with an average of 403 per monsoon season. Of these the majority (75%) is for boat seine and the rest for hooks and line.

Though the Valiathura pier is open to all fishermen during the southwest monsoon period for launching their catamarans, only fishermen of Valiaveli (Veli), Vettukadu, Kannenthura, Cheriathura, Poonthura and Panathura, besides Valiathura alone make use of this facility. The fishermen intending to launch the craft from the pier start moving their units to Valiathura by the end of May. The crafts are transported by bullock-carts and by lorries. Apart from transporting charges, coolie charges also will have to be paid for handling the logs upto the pier.

No remuneration in cash is paid to the fishermen engaged in this type of fishing, the sale proceeds of the catch being divided among the crew and others in the following manner: owner of the craft and gear, 40%; crew, 40%; church, 10%; barber, 3% and other helpers, 7%.

Fig. 1. Valiathura Pier

Fig. 2. Waiting for their turn-Catamarans are loaded on the trolley to be taken to the terminus of the pier.

Fig. 3. Loading the gear and other personal belongings.

Fig. 4. The catamaran is pushed into the sea.

Fig. 5. The catamaran being pushed into the sea followed by the crew.

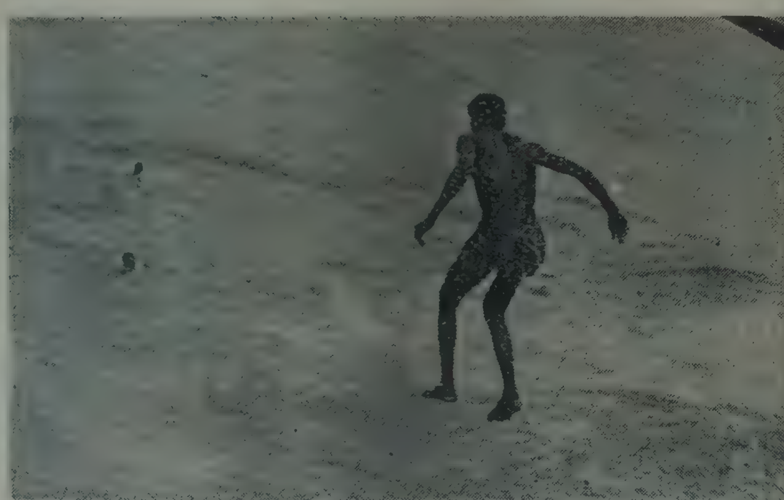


Fig. 6. Fisherman leaping into the turbulent sea.

Fishery

Observations on the trend of fishing effort and fish landings during 1977–1981 period at Valiathura and adjacent centres (Fig. 7) revealed an increase in the fishing activity in some centres during the southwest monsoon period (Figs. 8 & 9). The fishing effort has been standardized to boat seine unit, which is the common and effective fishing gear in this area (*Mar. Fish. Infor. Serv. T & E Ser.*, No. 38: 1982). During the monsoon period the fishing crafts of the adjacent centres also take off from Valiathura pier but land at their respective landing centres, as by tradition, fishing units not belonging to a particular centre are forbidden to land at that centre mainly due to problem of marketing. However, when the wind and water current conditions are not favourable to land at their respective centres, they may land at Valiathura or any other adjacent centres.

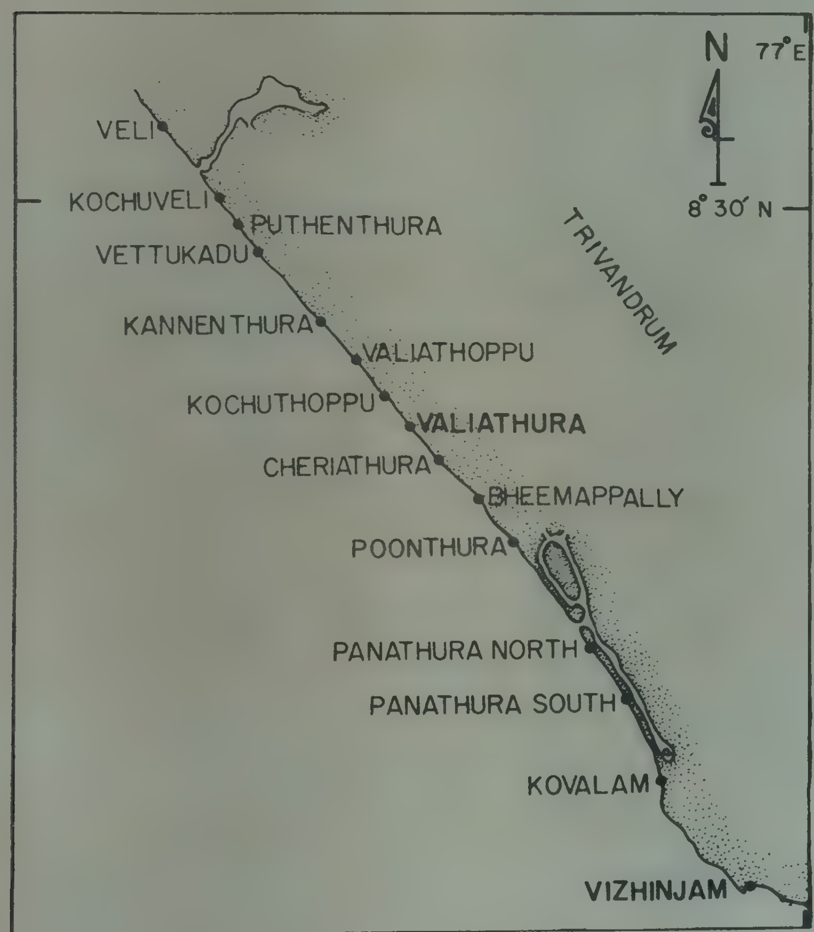


Fig. 7. Map showing Valiathura and adjacent landing centres.

Among the 14 centres, maximum fishing is carried out by the fishermen of Poonthura involving round the year operations of the indegenous gears. Kovalam, Panathura, Bheemapally, Cheriathura and Valiathura are the other important centres from where considerable quantities of fish are supplied to the markets in Trivandrum city. It could be seen from Fig. 9 that while at most of these centres the fishery is at its peak either before or after the monsoon season, at Valiathura it is maximum during the early part of the monsoon period due to the concentration of fishing activities on account of the launching facilities available there. The highest catch as well as catch rates of fish are recorded during the monsoon months at Valiathura, Cheriathura and Kochuveli. At the other centres while the most productive period falls outside the monsoon season relatively higher catch rates are recorded during the southwest monsoon months at Poonthura, Kannanthura, Valiathoppu and Kochuthoppu.

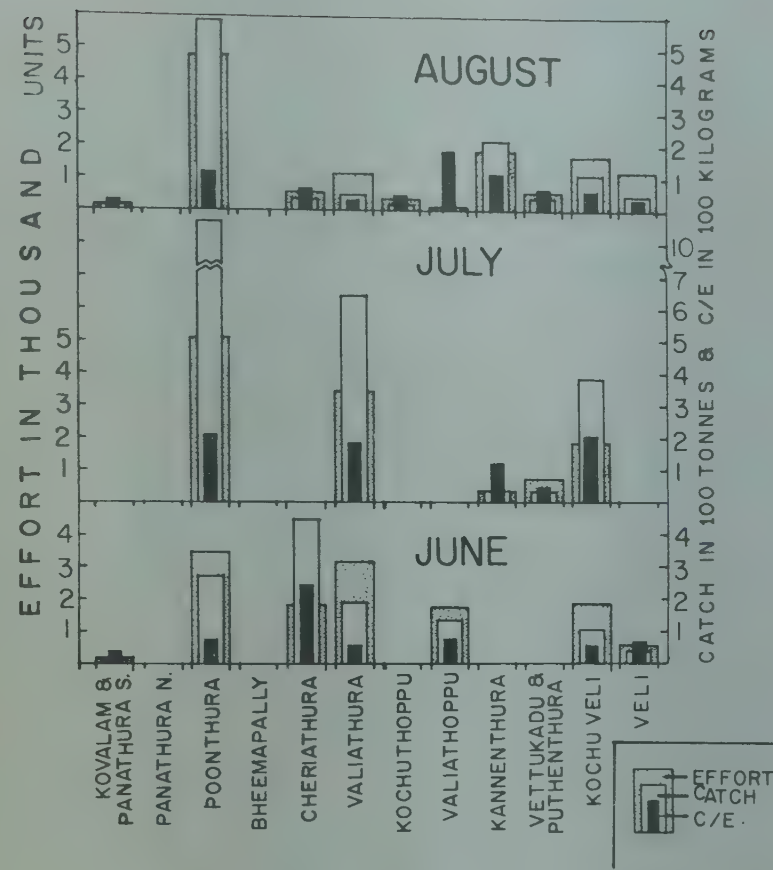


Fig. 8. Seasonal trend in the fishery (Effort, Catch and Catch/Effort) at Valiathura and adjacent centres.

The fish landings during monsoon period at Valiathura account for about 77% of the total annual landings at this centre. Similar figures for other centres are: Kovalam & Panathura, 7.3%; Panathura North, nil; Poonthura, 50%; Bheemapally, nil; Cheriathura, 45.6%; Kochuthoppu, 5.8%; Valiathoppu, 9.7%; Kannenthura, 16%; Vettukadu & Puthenthura, 6.4%; Kochuveli, 32% and

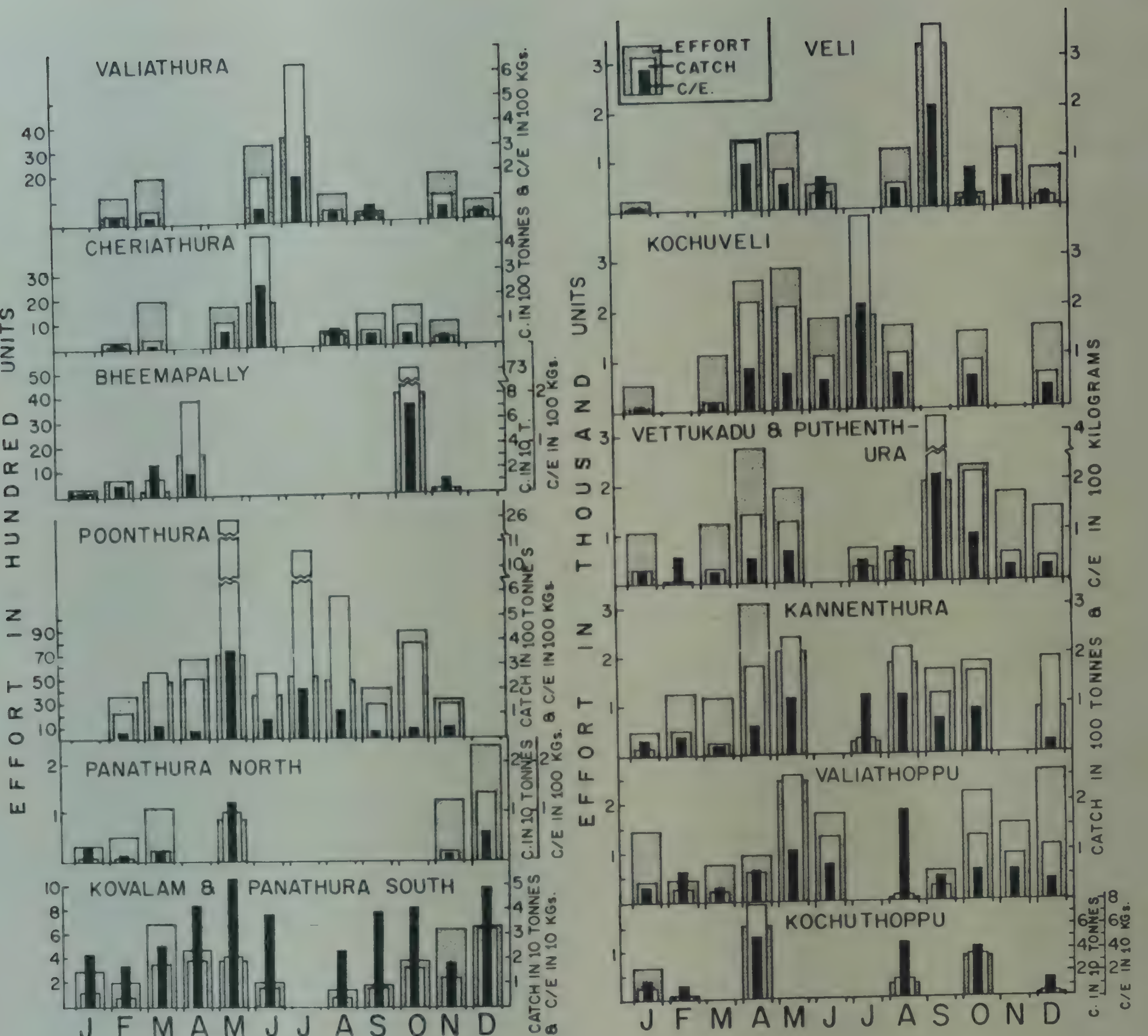


Fig. 9. Effort, Catch and Catch/Effort at different Centres during the southwest monsoon period.

Véli, 4.7%. As could be expected, no fishing activity takes place sometimes during the monsoon period at some of these centres due to rough sea. But the daring fishermen of Valiaveli, Vettukadu, Kannenthura, Cheriathura, Poonthura and Panathura brave the rough sea even during this period when the sea is relatively calm. Resumption of normal post-monsoon fishing activity takes place at most of the centres by about middle of August when the fury of the monsoon abates.

The major components of fish landed at Valiathura and the adjacent centres during this period are *Trichiurus haumela*, tunas (*Euthynnus affinis* and *Auxis thazard*), species of *Stolephorus*, namely *S. devisi*, *S. bataviensis* and *S. buccaneeri*, *Caranx* sp., *Nemipterus* sp. and *Saurida* sp. as well as perches. Species of *Loligo* and *Acetes* also contribute to a minor share during the monsoon period.

Remarks

Although the method adopted by the fishermen for launching of their catamarans is quite ingenious, it is most hazardous and full of perils. Out of sheer necessity to make a livelihood the fishermen have evolved this method when the stormy breakers of the monsoon season prevent them from launching their crafts into the sea. Accidents, sometimes fatal, often happen while launching or landing these fishing crafts. The catamaran on launching, may hit against the concrete pillars of the pier and break into bits. The fishermen sometimes sustain hits, cuts and fractures on jumping into the water, as waves dash them against the concrete pillar or the catamaran itself. Several such accidents have been reported. In this connection it would be most useful if the state Government think in terms of implementing insurance or some such schemes in order to help the fishermen and their family who get involved in such calamities.

EXPERIMENTAL TRAWLING OFF VIZHINJAM*

Introduction

A knowledge of the fishery potential of all regions of the coast line is an essential prerequisite for fishing beyond the traditional coastal fishing areas, especially in the context of exploitation of the resources of the Exclusive Economic Zone. Though there have been exploratory offshore fishing activities along the southern section of the southwest coast of India in recent years, they were mainly confined to areas off Kanyakumari and Quilon. As there is no information on the demersal fishery resources of the trawling grounds of Vizhinjam area the results of experimental trawling conducted there are presented in this account.

Fishing area and methods

Experimental trawling operations were conducted north of Vizhinjam, near the southern end of Kerala coast, in the area: 8-76/3 F, between latitude 8° 20′ N and 8° 30′ N and between longitude 76° 50′ E and 77° 00′ E employing the Research Vessel CADALMIN II of the Central Marine Fisheries Research Institute during March-April 1978 (Fig. 1). The vessel is 43½′ long and is fitted with 88 HP Ashok Leyland Marine Engine, a mechanical winch, and a Simrad Echo Sounder. It has a small laboratory with a capacity to accommodate seven personnel including scientists.

Three grounds in the depth ranges of 10-20 m, 20-30 m and 30-40 m were trawled. A total of 17 hauls of one hour duration each using otter trawl with a cod end mesh of 25 mm were made. The nature of the sea bed of these grounds is sandy with a slight admixture of mud. Sea urchins, gastropod shells and crabs were the invertebrate bottom fauna noted.

The weights of the different groups of fishes obtained in each haul were taken separately from which the total catch of fish in each haul was estimated, and random samples were taken from each group of fish for measuring the length of fish caught and for noting the maturity stage and food. Total length was recorded for fish and prawns.

*Prepared by M. D. K. Kuthalingam, G. Luther, S. Lazarus and K. Prabhakaran Nair

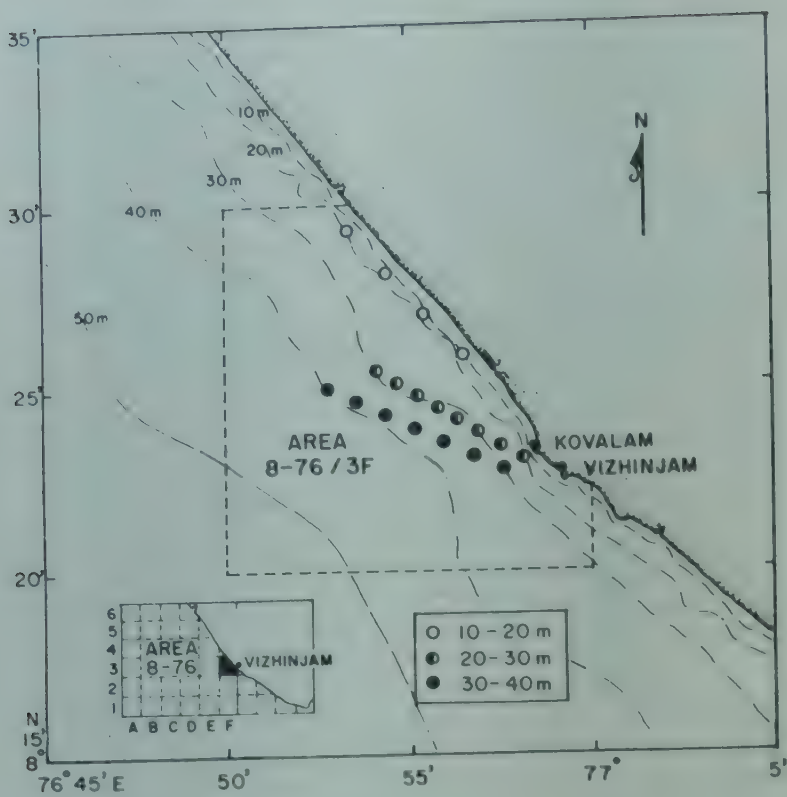


Fig. 1. Course of trawling made in fishing area 8-76/3 off Vizhinjam. Positions of trawl hauls made along the trawling track are represented by circles.

Results

The yield of fish and shell fish per hour of trawling in the different depth zones are presented in Table 1. It may be seen from the table that the total catch per hour of trawling increased steadily with increase in depth. Thus, the catch per hour was 25.2 kg at 10-20 m depth, 48.5 kg at 20-30 m depth, and 61.5 kg at 30-40 m depth. Prawns were met with only in 10-20 m depth zone and in negligible quantities during the period of observation. Though elasmobranchs were available in all the 3 depth zones, the catch rate for them was higher in 20-30 m depth. The catch rate for teleosts, however, increased with increase in depth. Crabs were more in shallower depth (10-20 m) and cephalopods in 30-40 m depth.

Table 1. *Catch per hour (in kg) for fish and shell fish in different depth zones*

Depth zone in m.	Number of hauls	Catch per hour (in kg): Fish: Elasmobranchs	Fish: Teleosts	Shell fish: Prawns	Shell fish: Crabs	Shell fish: Cephalopods	Total
10-20	4	3.0	16.0	4.0	1.5	0.7	25.2
20-30	8	13.0	35.2	—	—	0.3	48.5
30-40	7	8.4	48.5	—	0.6	4.0	61.5

Species composition

Important species of fish and shell fish in the catches and their size ranges are as follows:

1. Prawns: *Penaeus indicus* (98-147 mm) *P. monodon* (136-153 mm)
2. Cephalopods: *Sepia pharaonis* (83-225) mm), *S. aculeata*, (45-93 m) *Loligo duvaucelii* (35-137 mm), *Doryteuthis* sp. (58-85 mm), *Octopus* spp. (220-260 mm)
3. Sharks & skates: *Loxodon macrorhinus* (400-480 mm), *Scoliodon laticaudus* (450-550 mm), *Rhynchobatus djiddensis* (450-650 mm);
4. Rays: *Himantura bleekeri* (320-410 mm), *Trygon kuhlii* (181-382 mm), *Amphotistius imbricatus* (107-155 mm), *Aetobatus narinari* (292-315 mm), *Narcine timlei* (142-155 mm).
5. Synodontid: *Saurida tumbil* (205-325 mm)
6. Congrids: *Conger cinereus* (450-525 mm) *Uroconger lepturus* (420-515 mm).
7. Fistularid: *Fistularia villosa* (300-450 mm)
8. Carangids: *Caranx malabaricus* (120-160 mm), *C. williamsi* (164-195 mm), *C. chrysophrys* (175-195 mm), *C. djedaba* (110-140 mm), *C. sexfasciatus* (110-135 mm), *C. melampygus* (145-175 mm), *Selar kalla* (80-120 mm), *Megalaspis cordyla* (280-330 mm), *Decapterus dayi* (110-175 mm), *Alectis indica* (302-310 mm).
9. Nemipterids: *Nemipterus japonicus* (230-265 mm), *N. bleekeri* (96-200 mm).
10. Leiognathids: *Leiognathus bindus* (65-85 mm), *L. lineolatus* (60-75 mm), *Secutor insidiator* (52-85 mm), *S. ruconius* (50-75 mm).

Table 2. *Depthwise distribution of different categories of fish and shell fish (%) and ranges of salinity and temperature in the trawling grounds during March–April 1978*

Depth zone (m)	Categories of fish and shell fish (percentage of total catch)																			Salinity (0/00)		Temperature (°C)	
	Prawns	Cephalopods	Sharks	Rays & Skates	Synodontids	Congrids	Fistularid	Carangids	Nemipterids	Platycephalid	Psettodid	Bothid	Cynoglossid	Balistids	Diodontids	Leiognathids	Sciaenids	Trichiurid	Miscellaneous	Surface	Bottom	Surface	Bottom
10–20	12.5	2.8	5.6	6.9	5.6	13.9	4.2	9.7	11.1	8.3	—	—	—	—	5.6	8.3	5.6	—	—				
20–30	—	0.5	1.6	24.8	1.1	0.2	5.9	4.1	5.0	0.5	0.2	0.2	1.6	1.1	45.2	1.4	—	0.5	5.2	30.01 to 35.64	30.52 to 36.67	30.0 to 31.5	28.4 to 29.0
30–40	—	6.9	6.2	7.6	2.4	—	20.2	—	2.1	—	0.9	1.9	6.7	4.3	33.8	2.1	—	—	4.9				

11. Sciaenids: *Johnius dussumieri* (140–180 mm), *Otolithus ruber* (250–285 mm).
12. Trichiurid: *Trichiurus lepturus* (450–460 mm).
13. Platycephalid: *Grammoplites scaber* (114–210 mm)
14. Psettodid: *Psettodes erumei* (400–465 mm)
15. Bothid *Pseudorhombus javanicus* (277–315 mm)
16. Cynoglossid: *Cynoglossus semifasciatus* (40–145 mm)
17. Balistids: *Sufflamen capistratus* (135–164 mm), *Odonus niger* (124–135 mm)
18. Diodontids: *Diodon hystrix* (150–175 mm), *D. maculifer* (120–135 mm); *D. holacanthus* (100–120 mm)
19. Miscellaneous: *Lactarius lactarius, Lethrinus* spp., *Therapon jarbua, Sphyraena obtusata, Polynemus* spp., *Pampus argenteus, Tachysurus* spp., *Tetrasomus concatinatus, Arothron stellatus, Epinephelus* sp., *Triacanthus brevirostris, Gerres* spp., *Apogon enneastigma, Parapercis pulchella, Canthigaster margaritatus, Antennarius* sp., *Dactyloptena orientallis, Siganus oramin, S. javus* and *Thenus orientallis.*

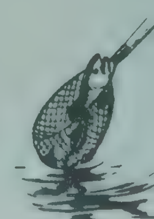
Mature gonads (in stages IV–VI ICES) were noticed in *Decapterus dayi, Caranx melampygus, Caranx chrysophrys, Sphyraena obtusta, Fistularia villosa, Grammoplites scaber* and *Psettodes erumei.*

Prawns and squids formed the principal food of *Fistularia villosa* and *Nemipterus bleekeri.* Early juveniles of *Leiognathus, Nemipterus* and *Stolephorus* formed the main food of *Alectis indica, Caranx melampygus, Caranx chrysophrys, Nemipterus japonicus, Grammoplites scaber* and *Otolithus ruber. Stolephorus* formed the exclusive food item of *Sphyaerna obtusata* and *Squilla* formed the chief food of *Gerres limbatus* during the period of observation.

Remarks

Each depth zone was found to be dominated by certain groups of fish and shell fish (Table 2). Thus, in the 10–20 m depth zone congrid eels, prawns, nemipterids, carangids, leiognathids, and platycephalid ranked high. Similarly diodontids and rays were dominant in the 20–30 m depth zone in comparison with the other two depth zones. Apart from diodontids, *Fistularia villosa,* was the most dominant species in the 30–40 m depth zone. These comparisons of the dominant catches in the three depth zones indicate that (1) quality fishes are abundant in 10–20 m zone, (2) diodontids dominate the catches in 20–30 m and 30–40 m depth zones, (3) rays and skates are relatively more abundant in 20–30 m depth zone, (4) cephalopods, fistularids and flat fishes are common in the 30–40 m depth zone and (5) prawns are present only in 10–20 m depth zone.

The overall picture emerging from the present experimental trawling operations is that of a steady increase in the catch per hour with increase in depth upto 40 m area during March–April period. The results are quite encouraging and indicate the availability of trawlable quantities of demersal fishes in these grounds. However, more intensive trawling should be attempted during different seasons in order to assess the potentiality of these trawling grounds.



IMPACT OF PURSE SEINE OPERATIONS ON TRADITIONAL FISHERY WITH SPECIAL REFERENCE TO OIL SARDINE IN KERALA DURING 1980 AND 1981*

Introduction

There has been a marked decline in the landings of oil sardine in 1980, compared to the previous two years. A study was undertaken to examine the reasons for this decline and to determine whether the purse seine operations which started in 1979 has any influence on the traditional fishery. For this purpose the data on catch, effort, age and length composition of oil sardine collected by this Institute during 1978-81 period pertaining to indigenous gears and purse seines and the data on socio-economic aspects gathered through a special survey in 1981 in the coastal villages of Kerala were considered.

The purse seiners have started operations in Cochin area during the latter half of 1979 with about 10 units, which increased to about 40 and 60 in 1980 and 1981 respectively. The purse seiners operated are of about 13 m. in length with nets measuring 500-600 m in length and 50-60 m in depth with the meshes ranging from 13 to 20 mm in size.

Catch and Effort

The estimates of marine fish landings, by purse seines and traditional gears during 1978 to '81 in the region Quilon to Manjeshwar where the impact of purse seining was reportedly experienced by the indigenous fishermen, are given in Table 1 along with the effort and the catch per unit effort (CPUE). As seen from the table the total landings by indigenous gears were about 1.9 lakh tonnes in 1978, 1.6 lakh tonnes in 1979, 0.9 lakh tonnes in 1980 and 1.7 lakh tonnes in 1981, thus showing a conspicuous drop in 1980. The CPUE and the effort also showed a decline in 1980. In the case of purse seines, the figures for 1979 are not comparable with those of 1980 and '81 since purse seiners started operating only in the latter half of 1979. The total landings of purse seines were about 15 thousand tonnes in 1980 against 18 thousand tonnes in 1981 thus showing a 20% increase. While the CPUE indicated a slight decline, the effort showed an increase.

In order to know the species which have registered a decline, the landings of oil sardine and mackerel were considered since these two are the largely exploited species by purse seines.

As regards oil sardine, catches by indigenous crafts were a little over one lakh tonnes during both 1978 and '79 which declined almost to its half in 1980. However, the landings revived remarkably in 1981 recording 1.3 lakh tonnes. CPUE also showed almost a similar trend during this period. For purse seines, landings increased from about 10 thousand in 1980 to 12 thousand tonnes in 1981 while the CPUE remained more or less the same.

The mackerel landings by indigenous gears indicated a decline during the period 1978 to '80 with nominal improvement in 1981. CPUE also showed a similar trend. The purse seine landings during 1981 showed a marginal decrease while CPUE registered a decline of about 27% as compared to 1980.

The contribution from mackerel landings to the total was about 10% only during this period under report, whereas the share of oil sardine to the total was over 60% and the trend of the total catches is well reflected by that of oil sardine. Hence landings of oil sardine were alone considered for the analysis in this report.

Age composition of oil sardine

Regarding length frequency distribution of oil sardine in purse seine catches in 1979 at Cochin, contributions of 0-year recruits (below 145 mm in total length) of the oil sardine was 80%. In 1980 and '81, however, they yielded about 71% indicating a decrease.

In the boat seine, Thanguvala the yield from the 0-year olds recorded a slight decrease in 1980 when compared to 1979 (Table 2). In the boat seine, Pattenkolli catch at Calicut, the contribution from the 0-year declined markedly in 1979 and 1980 compared to 1981. However, during 1981 the 0-year recruits recorded a remarkable increase coinciding with the improvement in the landings (Table 2).

Economic aspects

A special survey was conducted covering 41 fish landing centres in the region Quilon to Manjeshwar

*Prepared by T. Jacob, K. Alagaraja, S. K. Dharmaraja, K. K. P. Panikkar, G. Balakrishnan, U. K. Satyavan, V. Balan and K. V. N. Rao.

Table 1. *Contribution of purse seiners and indigenous crafts to the marine fish landings of the region Quilon to Manjeshwar in Kerala during 1978-1981.*

Years		1978		1979		1980		1981	
Species	Gears	Purse seine	Indigenous	Purse seine	Indigenous	Purse seine	Indigenous	Purse seine	Indigenous
1. Oil sardine	Catch (tonnes)	—	1,18,378	1,754	1,07,395	9,763	51,916	12,334	1,33,490
	CPUE (kg)	—	94	3,213	112	1,842	68	1,825	150
2. Mackerel	Catch (tonnes)	—	24,256	48	13,891	4,221	8,470	3,932	10,195
	CPUE (kg)	—	19	88	14	796	11	582	12
Total	Catch (tonnes)	—	1,91,423	1,841	1,58,436	14,858	92,903	17,673	1,73,192
	CPUE (kg)	—	152	3,372	165	2,803	122	2,614	195
	Effort (boat days)	—	12,61,652	546	9,58,720	5,301	7,62,119	6,760	8,87,707

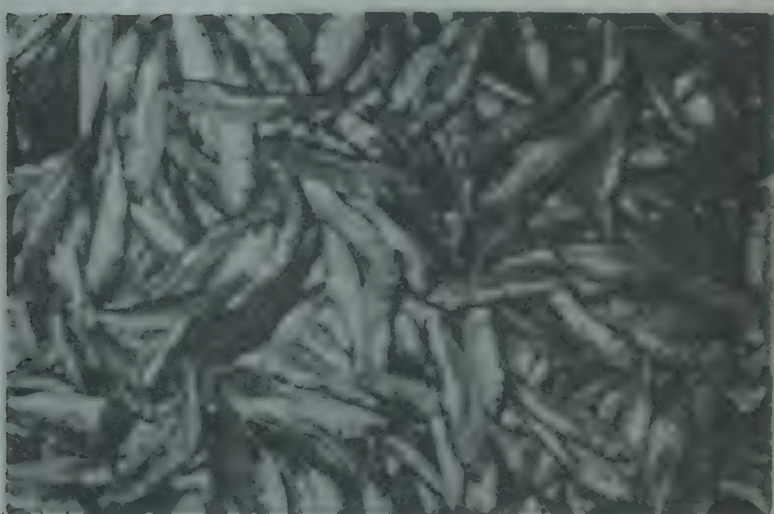
Table 2. *Age composition (%) of oil sardine at Cochin and Calicut during 1978-1981*

	Cochin						Calicut		
	Purse seine			Thangu vala (Boat seine)			Pattenkolli vala (Boat seine)		
Year	0 Yr	1+Yr	2+Yr & above	0-Yr	1+Yr	2+Yr & above	0 Yr	1+Yr	2+Yr & above
1978	No purse seining			67.4	27.4	5.2	81.3	11.3	7.4
1979	79.6	12.8	7.6	79.4	16.2	4.4	42.2	37.4	20.4
1980	71.4	15.6	13.0	74.8	22.7	2.5	43.5	34.6	21.9
1981	71.0	15.2	13.8	(No observation)			70.0	18.8	11.2

during May 1981, to find out the impact of purse seine operations, if any on the indigenous fisheries. Data were collected from country craft owners on general aspects of fishing activities at the landing centres. The data obtained through this survey indicated that landings by purse seiners at Cochin and Mangalore, lifted by trucks, moved out to various parts of Kerala State and sold at competitive prices when compared to local prices. To avail this advantage the head load and bicycle vendors waited for these trucks on the road and did not go to the landing centres to collect the country craft catches which were irregular, undependable and low. The number of trucks that used to visit these landing centres was reduced to one third as they got regularly full loads at places viz. Cochin and Mangalore. Before the introduction of purse seining, traditional fishermen were able to get higher price whenever the catch was less. Thus reduction in the quantity used to be compensated by higher price. But during 1980, even small catches of oil sardine failed to boost the prices at the landing centres because of the regular supply of purse seine catches. This is indicated by the average prices of 50 paise, 50 paise and 60 paise per Kg. ruled in 1979, '80 and '81 respectively. These factors would have played a major role in discouraging the indigenous crafts venturing in fishing in usual numbers. The aggregate revenue from the oil sardine landings by the indigenous crafts worked out to 5.4, 2.6

Fig. 1. Poor arrivals - hawkers in despair in 1980

Fig. 2. Auctioning of indigenous catches of oil sardine in 1981.



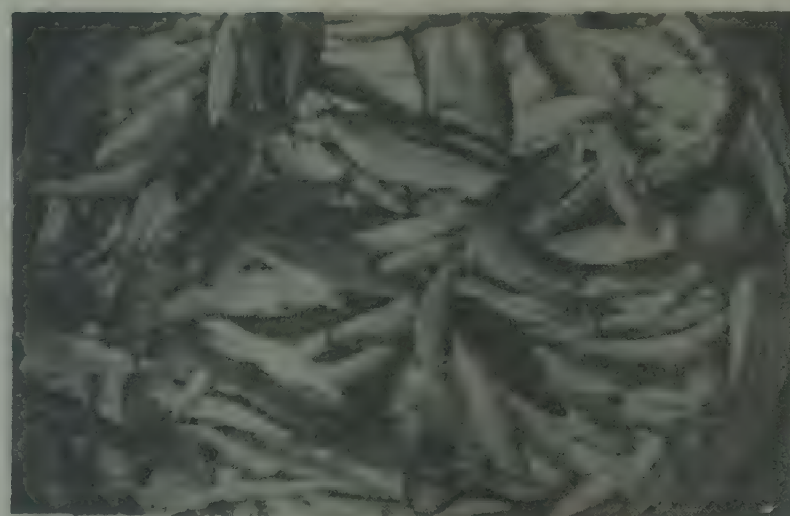


Fig.3 & 4. Bumper harvest of oil sardine in 1981.

Fig. 5. Purse-seiners and carrier boats at Fisheries Harbour, Cochin.

Fig. 6. Indigenous crafts auctioning catches

and 7.8 crores in 1979, '80 and '81 respectively, thus showing a steep fall in revenue during 1980. Fig. 7 shows the comparative value of the revenue per unit effort (Rupees per boat day) from oil sardine for the 3 years 1979 to 1981.

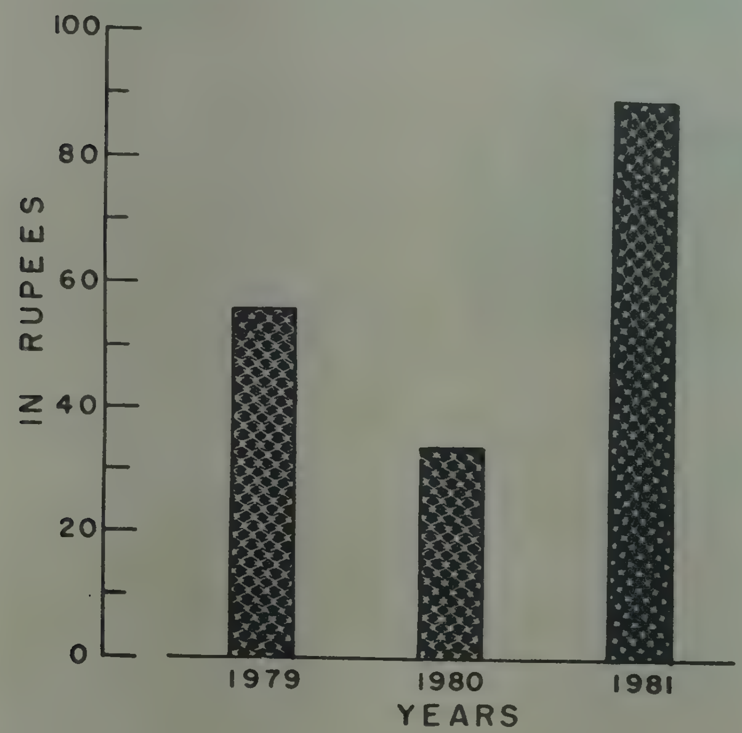


Fig. 7. Revenue from oil sardine per unit effort of indigenous craft (Rupees/boat day)

As per the data collected from country craft owners, during 1980 about 10 percent of the active fishermen have left fishing. Some of them were engaged in road repairing, rubble work, metalling and head load work, etc. At certain centres like Kannamali and Manasseri, a number of fishermen shifted from marine fishing to back water fishing at least temporarily. Even those who did marine fishing were mostly underemployed. The annual average income of a fishermen family has been found reduced by about 50% in 1980 as compared to 1979. The survey further revealed that about 250 traditional fishermen were employed in purse seiners in Cochin Fisheries Harbour.

As stated earlier, in 1981 there has been a revival of oil sardine fishery. The better availability induced the fishermen to increase the effort which helped the indigenous crafts to provide regular supply. Besides, the motorisation of the indigenous crafts which picked up during the latter half of 1981 from Quilon to Munambam also helped in increasing the sardine catches to some extent. These increased landings attracted more traders towards the landing centres which resulted in the flourishing of marketing and related activities.

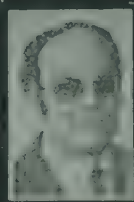
Discussion

The oil sardine catches in purse seine and Thanguvala at Cochin indicated a greater contribution from 0-year class during 1979 when compared to 1980. This is reflected in the better catches in 1979 than in 1980. Manifestation of the purse seining impact, though noticed, was not on a large scale in 1980. The dwindled availability or decrease in the stock might have affected the catches of the artisanal gears operating in the nearshore waters. The diminished interest shown by artisanal fishermen due to reduced returns also might have brought about a reduction in the landings in 1980. However, in 1981 the oil sardine fishery improved remarkably consequent on better availability and increased effort. From the foregoing analysis it appears that the effect of purse seining, at the present level of exploitation and availability, is not tangibly felt on the indigenous fishery off Kerala coast.

NEWS - INDIA AND OVERSEAS

Aquaculture Scientist visits CMFRI

One of the recent visitors at the Central Marine Fisheries Research Institute, Cochin was the veteran scientist and aquaculturist Dr. Ronald J. Roberts, Director, Institute of Aquaculture, University of Sterling, Scotland. His impressions on the work he saw in the prawn culture programme of the Institute is reproduced below from his column in Fish Farming International 9(3) of May 1982.



FISH VET'S DIARY

by Dr. Ronald J. Roberts,
Director, Institute of Aquaculture,
University of Stirling, Scotland.

Prawns among the rice

IN MY last diary I talked about my visit to the Fisheries College in Mangalore, and the First All-India Symposium on Fish Diseases. I also mentioned how impressed I was by the completely self-sustained progress which the Indians had made towards successful large-scale prawn culture.

The prawn culture programme is carried out under the aegis of one of India's most capable scientists, the Director of Marine Fishery Research, Dr. E. G. Silas, a deeply committed, thinking man who always held that the highest standards of research are allied to satisfying the practical need to feed people and improve their economy.

SCEPTICAL

Since he was justifiably sceptical of the advantages of trying to adapt not terribly efficient Western high capital techniques to India, and dubious of his ability to justify expenditure by achieving the very high price rate of £1 or more per individual prawn, which apply in Japan, Dr. Silas determined to gather together a team around him which would develop their own, low cost, prawn production system, *de novo*.

They set up a research sation at Narakkal, close to the research headquarters in Cochin, and off they went. Cochin is a cosmopolitan shipping port on the coast of Kerala, where the population is said to be the most highly educated in India. It is also the most politically aware, with massive demonstrations in favour of one party or another, obstructing its traffic with great regularity. However, just outside Cochin, agriculture and fishing is the norm and there was already a sort of planned management of prawn capture. It was very similar to the Camacchio Lagoon system, near Venice, where sluices allow migrating eels into lagoons but catch them when they go back out.

Apart from the rather less exotic architecture, Cochin, with its islands and boats has similarities with Venice but the prawn lagoons are really rice fields — there is a local rice variety which grows well in brackish water, and it is this "paddy" which provides the basis for the culture. Rice only provides one crop, the rest of the year very little may be done with the fields and it was to this that Dr. Silas and his team turned their attention.

The normal common prawn of the area is a slow growing small one called *Penaeus dobsonii*. The much more valuable *P. indicus*, larger and faster growing would have much greater potential and it was to this that the group turned their attention. The result is now history.

SUCCESSFUL

They resolved all the growth stages of the prawn, they developed a technique for completely continuous availability of *nauplii* and continuous production of diatoms, rotifers and cladocerons to feed all the larval stages, and devised foods for feeding in the ponds where necessary.

So successful has the technique been that villages to which the young prawns are supplied can achieve three crops a year at 500 kg of prawn per hectare. It is little wonder they are keen to abandon rice and do even more, but Dr. Silas discourages this. The prawns are usually sold, the rice feeds the villages.

SPARTAN

The work at Narakkal deserves to be much more widely recognised. It is a developing country's own application of its own efforts in a local context.

Narakkal is a spartan place — it still has no piped water — but its achievements have now been rewarded by receiving one of India's premier national awards for research, the Sukamara Basu prize. It is not often that aquaculturists are recognised in competition with all other scientists at such a prestigious level, and it is to be hoped that India's success in already reaching a production level of 10,000 tons of highest quality prawns a year in such a short time can be built upon — for the mass prawn consumer market as well as the producers.

Brine shrimp nutritional quality varies

Brine shrimp is the premier live food organism used by aquaculturists the world over. This is mostly because of the convenience it provides for keeping in dried form and bringing to life as needed and also due to the necessary nutrients it provides for finfish and shellfish in certain critical larval stages of their development.

The brine shrimp or *Artemia*, as it is known zoologically, are tiny creatures, not more than a few mm in length. They are not shrimp at all, but a more primitive crustacean, which under the microscope looks somewhat like a man from outer space. Although it never occurs in the ocean, it can survive in waters that range from one tenth to three times the salinity of the ocean. To date brine shrimp have been found in over 160 locations worldwide, consisting of several strains.

Under a project funded by the National Sea Grant Program, scientists at the University of Rhode Island have undertaken the evaluation of chemical and biochemical characteristics of brine shrimp. They have established that *Artemia* is quite a variable biological material and different batches, different strains and ages of brine shrimp from different geographical locations vary greatly in nutritional quality. If an aquaculturist gets poor results from feeding *Artemia*, the fault is more likely due to the variation in nutritional quality of the particular strain used by him.

Aquaculture Magazine 8(1): Nov./Dec. 1981

Cultured marine snails for research

In the Marine Biological Laboratory at Woods Hole simple, less known marine animals are being cultured for use in neurobiological research. A team of scientists headed by Dr. Eric R. Kandel is using the cultured marine snails *Aplesia californicus*, commonly known as sea hares with average adult size of 15 to 20 cm, length and weighing upto 0.5 kg, for research experiments.

It has been known that human beings share many common behavioural patterns with simpler animals, including elementary percaption and motor coordination. The capacity to learn, in particular, is widespread and has evolved in many invertebrate animals and in all vertebrates. Simple invertebrates with lesser number of cells in the nervous system are, therefore, more suited for experimentation to relate the function of individual cells to behaviour. So the cultured snails are made use of in these experiments to study behaviour pattern. Some of the important findings lead to a new way of looking at the relation between the brain and behaviour.

Aquaculture Magazine 8(2): Jan/Feb. 1982

African perch to be released in Australia

The Queensland Government in Australia has drawn up a project with the intention to test the African fresh water sportfish Nile perch for possible release in the State. Fingerlings of the fish will be brought to Australia for trials which would last up to six years. If the trials showed that the Nile perch posed a threat to native fish fauna the programme would be abandoned and all stock held would be destroyed.

The trials will be conducted at a research centre on the Atherton Tableland in the north of Queensland. The first year of the project would be spent in building special ponds and security fences, after which the fingerlings would be collected and transported to Australia by special staff. The handling and care of the fingerlings would be discussed with fisheries experts of FAO. If the fish proves no threat to native fish and are adaptable to local conditions, they will be released into selected rivers and dams.

World Fishing 31(4): April 1982

Compiled and prepared by M. J. George, S. K. Dharmaraja, G. Subbaraju and C. Suseelan,
Published by Dr. M. J. George, Senior Scientist on behalf of the Director, Central Marine Fisheries Research Institute, Cochin - 682 018. Phototypeset and printed at PAICO, Cochin 31.

MARINE FISHERIES INFORMATION SERVICE

No. 41
AUGUST, 1982

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THE MARINE FISHERIES INFORMATION SERVICE: Technical and Extension Series envisages the rapid dissemination of information on marine and brackish water fishery resources and allied data available with the Fishery Data Centre and the Research Divisions of the Institute, results of proven researches for transfer of technology to the fish farmers and industry and of other relevant information needed for Research and Development efforts in the marine fisheries sector.

Abbreviation – *Mar. Fish. Infor. Serv. T & E Ser., No.* 41: 1982

CONTENTS

1. Trends in marine fish production in India—1981

Cover photo : Collection of catch statistics at a fish landing centre

TRENDS IN MARINE FISH PRODUCTION IN INDIA—1981[III]

The total marine fish production in India during 1981 was estimated at 13,78,457 tonnes as compared to 12,49,837 tonnes during 1980, showing an increase of about 10%. While West Bengal, Tamil Nadu, Pondicherry, Karnataka, Goa, Maharashtra, Gujarat and Lakshadweep recorded higher landings, Orissa and Kerala accounted lower catches as compared to 1980. The catch in Andhra Pradesh and Andamans remained more or less same (Table 1).

Table 1. *Statewise total marine fish landings in India during the years* 1981 *and* 1980 *(in tonnes)*

Sl.No.	State	1981	1980
1.	West Bengal	20,107	6,097*
2.	Orissa	35,655	39,375
3.	Andhra Pradesh	1,16,143	1,16,013
4.	Tamil Nadu	2,21,296	2,17,394
5.	Pondicherry**	10,755	9,390
6.	Kerala	2,74,395	2,79,543
7.	Karnataka	1,53,349	1,15,322
8.	Goa***	34,498	24,490
9.	Maharashtra	2,72,587	2,31,763
10.	Gujarat	2,34,510	2,03,494
11.	Andamans	1,862	1,803
12.	Lakshadweep	3,300	2,909
13.	Private trawlers†	—	2,244
	TOTAL	13,78,457	12,49,837

* Contai coast only

** Excluding Mahe and Yenam which are included in Kerala and Andhra Pradesh respectively.

*** Excluding Daman and Diu which are included in Gujarat.

† Partial coverage of larger trawlers. Comparable figure for 1981 is not available.

Pelagic and demersal group of fishes

The specieswise composition of total marine fish landings in India is shown in Table 2. The pelagic group of species comprises of *Chirocentrus,* oil sardine, lesser sardines, hilsa shad, other shads, *Stolephorus,* (white bait), *Thryssa, Setipinna, Coilia,* other clupeoids, Bombay duck, half beaks and full beaks, flying fish, ribbon fish, carangids, mackerel, seer fish, tunnies, barracudas, mullets and unicorn cod. The elasmobranchs, eels, catfishes, lizard fishes, perches, red mullets, polynemids, sciaenids, silverbellies, *Lactarius,* pomfrets, soles, prawns, lobsters and cephalopods form the demersal group. The statewise break-up of pelagic and demersal groups of fishes is shown in Table 3 and Fig. 1.

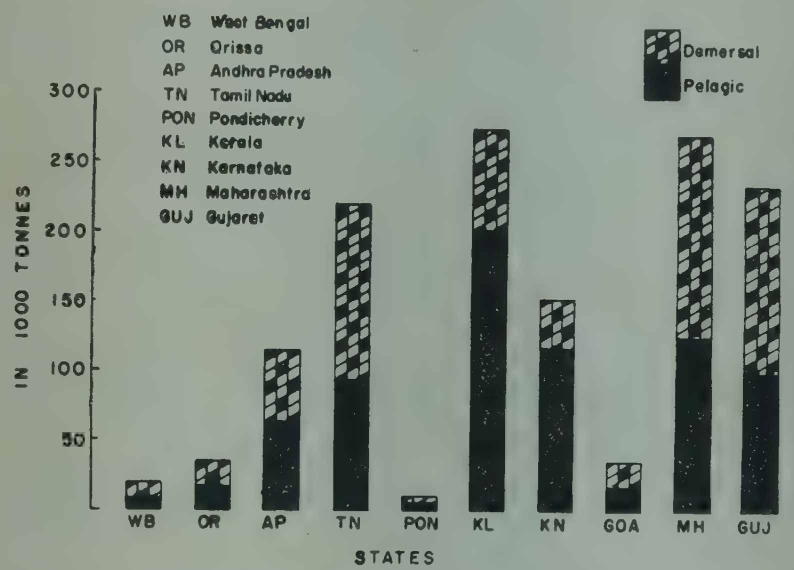

Fig. 1. Pelagic and demersal catch in different states during 1981

From Table 3 it is noticed that Kerala accounted for the highest catch of pelagic group of fishes during 1981, followed by Maharashtra, Karnataka, Gujarat, Tamil Nadu and Andhra Pradesh. As regards demersal group of fishes, Maharashtra recorded the maximum catch followed by Gujarat, Tamil Nadu, Kerala, Andhra Pradesh and Karnataka.

All India marine fish production during 1971 to 1981

Table 4 shows the all India total marine fish production and species composition for the 11 year period 1971 to 1981. The production figures show a fluctuating trend between 1971 and 1981, the maximum and minimum landings being 1.42 million in 1975 and 0.98 million tonnes in 1972 respectively. The landings during 1981 formed about 97% of the maximum catch recorded in 1975. The trends in marine fish production in respect of various maritime states of India are shown in Tables 5 to 17.

III Prepared by Fishery Resources Assessment Division

Table 2. *Estimated marine fish landings in India during* 1981 *(in tonnes)*

Sl. No.		Name of fish	West Bengal	Orissa	Andhra Pradesh	Tamil Nadu	Pondi-cherry	Kerala	Karna-taka	Goa	Maha-rashtra	Guja-rat	Anda-mans	Laksha-dweep	Total
1.		Elasmobranchs													
	a.	Sharks	311	2,293	2,869	2,240	193	3,580	3,929	881	7,471	9,134	21	189	33,111
	b.	Skates	170	—	367	124	—	120	—	—	176	101	—	—	1,058
	c.	Rays	113	917	2,000	10,878	194	1,171	136	169	2,028	4,198	14	22	21,840
2.		Eels	—	24	406	93	13	3	—	19	2,290	2,179	—	—	5,027
3.		Catfishes	4,449	6,084	4,250	3,792	102	9,562	7,503	2,211	11,045	10,370	22	—	59,390
4.		Clupeoids													
	a.	Wolf herring *(Chirocentrus)*	296	1,281	1,111	1,820	85	973	118	181	2,918	2,986	25	—	11,794
	b.	Oil sardine	—	—	—	195	—	1,46,986	65,614	7,609	622	—	—	—	2,21,026
	c.	Other sardines (Lesser sardines)	—	4,535	15,719	24,448	1,342	7,629	5,328	2,296	420	—	263	—	61,980
	d.	Hilsa shad *(Hilsa ilisha)*	2,672	2,085	40	52	—	8	1	2	530	17	—	—	5,407
	e.	Other shads (Other *Hilsa*)	44	353	1,343	3,516	129	15	331	26	2,201	10,283	26	—	18,267
	f.	Anchovies													
		Coilia	245	43	54	203	6	—	1	—	17,164	2,466	—	—	20,182
		Setipinna	456	114	177	285	70	—	—	—	—	—	—	—	1,102
		Stolephorus (Anchoviella)	4	86	13,829	8,357	507	4,293	5,959	108	55	—	185	—	33,383
		Thryssa (Thrissocles)	66	322	2,523	6,465	520	634	296	593	944	1,274	—	—	13,637
	g.	Other clupeoids	2,407	2,050	4,942	5,038	394	944	950	341	3,150	4,601	—	—	24,817
5.		Bombay duck *(Harpodon nehereus)*	618	73	845	3	—	—	—	1	82,136	54,114	—	—	1,37,790
6.		Lizard fishes *(Saurida & Saurus)*	—	108	1,024	1,455	246	5,691	333	707	1,308	110	—	—	10,982
7.		Half beaks & full beaks *(Hemirhamphus & Belone)*	1	2	29	819	57	565	148	2	46	—	17	113	1,799
8.		Flying fishes	—	—	—	2,460	614	16	—	—	—	—	3	16	3,109
9.		Perches													
	a.	Rock cods	—	1	35	549	13	734	10	3	119	189	—	—	1,653
	b.	Snappers	—	10	210	553	—	76	53	3	136	328	—	—	1,369
	c.	Pig face breams	—	—	—	771	17	91	1	—	7	—	—	—	887
	d.	Threadfin breams	—	7	2,049	1,687	407	6,442	256	562	2,156	2,055	—	—	15,621
	e.	Other perches	37	104	3,400	2,893	495	1,206	79	615	199	2,260	192	315	11,795
10.		Goat fishes (Red mullets)	—	104	684	1,116	155	33	—	60	982	294	—	25	3,453
11.		Threadfins (Polynemids)	312	566	776	236	1	47	—	14	711	1,585	—	—	4,248
12.		Croakers (Sciaenids)	270	2,133	7,046	13,140	330	3,145	2,295	1,610	17,475	35,242	—	—	82,686
13.		Ribbon fishes	161	995	8,207	7,605	217	7,066	235	684	8,048	8,327	24	—	41,569
14.		Carangids													
	a.	Horse mackerel	—	68	275	16	—	55	999	113	135	757	—	—	2,418
	b.	Scads	—	97	3,523	1,265	162	1,688	13	—	—	—	—	—	6,748
	c.	Leather jackets *(Chorinemus)*	62	196	453	608	32	318	148	44	360	2,764	—	—	4,985
	d.	Other carangids	—	150	1,415	12,735	1,507	2,989	2,429	565	1,014	89	196	105	23,194

Table 2 Contd.

Sl. No.	Name of fish	West Bengal	Orissa	Andhra Pradesh	Tamil Nadu	Pondicherry	Kerala	Karnataka	Goa	Maharashtra	Gujarat	Andamans	Lakshadweep	Total
15.	Silverbellies (*Leiognathus* & *Gazza*)	—	733	9,856	50,942	975	2,826	1,638	2,075	129	—	275	—	69,449
16.	Big-jawed jumper (*Lactarius*)	—	49	817	818	44	879	515	820	500	3,769	—	—	8,211
17.	Pomfrets													
a.	Black pomfret	8	780	1,778	524	96	616	53	103	2,965	2,853	1	—	9,777
b.	Silver pomfret	2,770	2,903	891	143	27	747	358	20	14,178	16,147	5	—	38,189
c.	Chinese pomfret	540	2	29	3	—	10	8	—	1	169	—	—	762
18.	Mackerel													
a.	*R. kanagurta*	—	823	3,255	3,900	308	16,200	19,766	3,939	289	—	156	—	48,660
b.	Other mackerel	—	—	—	16	8	—	—	—	—	—		—	
19.	Seer fishes													
a.	*S. commersoni*	1,072	91	1,082	4,900	49	1,580	1,237	447	1,717	1,516	76	25	13,792
b.	*S. guttatus*	57	2,424	2,468	515	52	1,744	842	165	1,097	4,020	73	25	13,482
c.	*S. lineolatus*	—	25	13	16	—	6	188	31	—	—	—	—	279
d.	*Acanthocybium* spp.	—	—	—	—	—	—	—	—	—	—	—	—	—
20.	Tunnies													
a.	*E. affinis*	—	105	194	3,062	6	4,076	2,516	48	235	1,383	—	23	11,648
b.	*Auxis spp*	—	—	—	77	—	1,124	1	—	—	—	—	—	1,202
c.	*K. pelamis*	—	—	—	19	—	—	—	—	7	—	33	1,744	1,803
d.	*T. tonggol*	—	—	—	—	—	22	—	—	47	14	—	—	83
e.	Other tunnies	—	145	144	662	49	287	—	140	959	203	9	469	3,067
21.	Bill fishes	—	1	204	148	17	129	3	5	72	—	—	17	596
22.	Barracudas (*Sphyraena*)	—	9	124	948	50	812	75	38	16	1	40	12	2,125
23.	Mullets (*Mugil*)	1	—	182	409	5	120	1	206	35	1,118	78	—	2,155
24.	Unicorn cod (*Bregmaceros*)	—	—	—	—	—	—	—	—	13	451	—	—	464
25.	Flat fishes													
a.	Halibut (*Psettodes erumei*)	—	—	46	204	6	158	—	—	26	180	—	—	620
b.	Flounders	—	—	1,037	29	—	—	—	727	69	—	—	—	1,862
c.	Soles	4	47	1,130	1,198	188	4,876	545	—	1,689	3,705	—	—	13,382
26.	Crustaceans													
a.	Penaeid prawns	244	1,328	6,728	13,548	336	22,268	4,122	2,237	21,717	10,985	26	—	83,539
b.	Non penaeid prawns	1,251	55	1,607	704	53	160	4	—	52,854	4,742	—	—	61,430
c.	Lobsters	—	3	1	238	5	50	—	9	388	786	1	—	1,481
d.	Crabs	—	147	1,512	9,168	236	168	650	526	112	14,083	14	—	26,616
e.	Stomatopods	—	145	288	317	—	2,830	8,718	2,170	384	2,466	—	—	17,318
27.	Cephalopods	—	57	512	1,687	44	2,376	266	94	1,755	2,743	—	14	9,548
28.	Miscellaneous	1,466	982	2,644	11,684	393	4,251	14,678	1,279	5,487	7,453	87	186	50,590
	TOTAL	20,107	35,655	1,16,143	2,21,296	10,755	2,74,395	1,53,349	34,498	2,72,587	2,34,510	1,862	3,300	13,78,457

Table 3. *Statewise break-up of the landings of pelagic and demersal group of fishes during 1981 (in tonnes)*

Sl.No.	State	Pelagic	Demersal	Total
1.	West Bengal	8,804	11,303	20,107
2.	Orissa	16,528	19,127	35,655
3.	Andhra Pradesh	63,663	52,480	1,16,143
4.	Tamil Nadu	95,609	1,25,687	2,21,296
5.	Pondicherry	6,421	4,334	10,755
6.	Kerala	2,03,431	70,964	2,74,395
7.	Karnataka	1,18,545	34,804	1,53,349
8.	Goa	18,261	16,237	34,498
9.	Maharashtra	1,26,782	1,45,805	2,72,587
10.	Gujarat	99,548	1,34,962	2,34,510
11.	Andamans	1,263	599	1,862
12.	Lakshadeep	2,701	599	3,300
	TOTAL	7,61,556	6,16,901	13,78,457

Statewise marine fish production

West Bengal

During 1981, the total marine fish landings in West Bengal were estimated at about 20,000 t in comparison to 6,000 t in 1980. However, it may be noted that during 1981, 24 Parganas district was covered for the first time in addition to Contai coast of Midnapore district in the regular survey programme for marine fish catch estimates in West Bengal. The species that were landed in substantial quantities were catfishes (4,400 t, 22%), pomfrets (3,300 t, 16%), hilsa shad (2,700 t, 13%), other clupeoids (2,400 t, 12%), non-penaeid prawns (1,300 t, 6%) and seer fish (1,100 t, 5%). Table 5 shows the specieswise composition of marine fish landings in West Bengal during the years 1976 to 1981. Prior to 1976, the estimates for West Bengal were combined with that of Orissa and the combined figures for West Bengal and Orissa are shown in Table 6 for the years 1969 to 1975.

Orissa

The total catch declined by about 3,700 t (9%) in 1981 as compared to previous year. The reduction in the total landings was mainly due to a fall in the catches of pomfrets and hilsa shad whose catches were lower by about 5,400 and 3,000 t respectively. The catch of catfishes and lesser sardines, however, increased by about 4,000 and 2,600 t respectively. Table 7 shows the specieswise composition of marine fish catch in Orissa for the years 1976 to 1981.

Andhra Pradesh

No vaiiation was seen in the total catch during 1981, the estimated catch for 1980 and 1981 being about 1.16 lakh tonnes each. The species that showed an increase in their landings were white baits, silverbellies, catfishes, lesser sardines, penaeid prawns and perches, the increase being 7,600, 6,100, 1,900, 1,800, 1,500 and 1,000 t respectively. This was offset by the decrease in the landings of ribbon fish, *Thryssa,* mackerel, non-penaeid prawns and sciaenids, the decrease in their landings being 7,400, 4,800, 2,900, 2,700 and 2,500 t respectively. The specieswise composition of marine fish landings in Andhra Pradesh for the years 1971–1981 are shown in Table 8.

Tamil Nadu

The total landings in Tamil Nadu during 1981 increased marginally by about 4,000 t as compared to 1980 with a significant increase in the landings of silverbellies to the extent of about 13,000 t. The catch of penaeid prawns, other crustaceans and *Thryssa* also showed an increase of about 4,500, 3,300 and 1,400 t respectively. A decline in the landings of croakers, lesser sardines, white baits, elasmobranchs and seer fish by about 6,400, 5,500, 4,800, 2,200, 1,700 t respectively was also noticed. Table 9 shows the specieswise composition of marine fish catch in Tamil Nadu for the years 1971 to 1981.

Pondicherry

An increase of about 1,400 t (15%) in the total catch was noticed during 1981 when compared with that of 1980. While the landings of carangids, flying fish and perches increased by 1,200, 600 and 300 t respectively, the catch of lesser sardines declined by about 1,400 t. The specieswise composition of marine fish production in Pondicherry during the years 1971 to 1981 is shown in Table 10.

Kerala

The total catch in Kerala during 1981 declined marginally by about 5,100 t (2%) compared to the previous year. A significant increase in the catch of oil sardine by about 77,000 t was noticed. However, another major fishery of this state, prawn fishery, suffered a set back with a decline of about 30,000 t. This was to a great extent due to the fall in the catches of prawns in Sakthikulangara, to the tune of about 27,000 tonnes in 1981 as compared to 1980. The other important species that showed a decline in their landings were

Table 4. *Composition of marine fish landings in India during 1971 to 1981 (in tonnes)*

Sl. No.		Name of fish	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
1.		Elasmobranchs	41,348	46,237	44,917	66,054	65,230	54,605	62,216	61,621	52,843	57,862	56,009
2.		Eels	4,056	4,509	3,869	4,011	5,710	8,296	12,997	8,781	7,155	12,082	5,027
3.		Catfishes	48,858	42,443	52,642	76,196	68,689	43,540	53,504	39,231	48,817	43,745	59,390
4.		*Chirocentrus*	9,366	9,532	11,090	9,026	11,813	10,368	11,909	10,990	10,274	12,805	11,794
5.	a.	Oil sardine	2,09,261	1,27,568	1,44,395	1,26,676	1,59,240	1,69,262	1,50,130	1,68,078	1,53,971	1,15,744	2,21,026
	b.	Lesser sardines	61,283	44,629	1,08,523	83,921	1,12,117	1,00,000	65,724	52,838	68,351	67,053	61,980
	c.	*Hilsa ilisha*	1,769	1,409	404	4,248	8,897	7,842	4,189	9,894	12,068	6,996	5,407
	d.	Other *Hilsa*	10,361	12,229	11,918	7,541	7,567	8,482	14,651	12,800	8,672	9,127	18,267
	e.	*Anchoviella*	19,516	18,699	25,394	41,507	30,744	30,069	34,033	39,054	26,588	33,684	33,383
	f.	*Thrissocles*	10,801	11,130	13,194	11,433	9,997	17,660	9,929	14,304	16,628	19,342	13,637
	g.	Other clupeoids	24,100	28,490	35,350	43,226	52,786	57,164	41,458	37,020	33,965	38,270	44,999
6.	a.	*Harpodon nehereus*	71,508	51,570	64,345	61,138	99,614	87,075	85,236	1,25,481	1,26,044	95,505	1,37,790
	b.	*Saurida* & *Saurus*	3,687	4,748	4,049	12,520	14,323	5,292	8,525	10,808	11,154	11,332	10,982
7.		*Hemirhamphus* & *Belone*	1,018	687	1,110	4,574	1,980	1,169	2,311	1,478	1,577	1,653	1,799
8.		Flying fish	9,179	1,415	6,388	1,012	1,832	1,439	643	1,681	2,546	1,255	3,109
9.		Perches	12,993	15,247	21,513	36,837	35,232	18,162	31,799	49,312	35,657	38,541	31,325
10.		Red mullets	3,881	6,004	3,925	7,009	2,641	5,216	2,422	2,984	3,130	2,416	3,453
11.		Polynemids	7,252	7,100	9,248	10,637	14,044	14,573	3,929	5,469	5,809	6,056	4,248
12.		Sciaenids	36,903	40,159	87,682	79,261	1,14,535	87,581	99,887	96,379	93,018	89,360	82,686
13.		Ribbon fish	44,690	36,225	53,106	63,029	57,330	64,542	42,407	77,785	71,349	62,690	41,569
14.	a.	*Caranx*	20,592	27,009	25,298	19,316	23,005	25,745	30,666	16,956	28,942	24,265	9,166
	b.	*Chorinemus*	2,109	2,952	2,827	3,797	3,380	3,322	4,119	3,359	3,307	4,182	4,985
	c.	*Trachynotus*	17	2	189	122	64	35	80	106	195	40	
	d.	Other carangids	304	308	129	91	207	1,572	219	423	465	945	23,194
	e.	*Coryphaena*	59	222	228	286	411	261	226	64	146	302	
	f.	*Elacate*	347	403	529	229	221	383	429	568	880	379	
15.	a.	*Leiognathus*	32,510	32,314	48,127	50,902	39,813	42,445	34,504	41,777	55,266	54,400	69,449
	b.	*Gazza*	156	78	41	338	424	966	61	104	197	186	
16.		*Lactarius*	5,313	7,579	13,912	8,913	11,848	12,045	10,961	7,906	4,474	7,415	8,211
17.		Pomfrets	21,000	19,007	22,052	22,421	24,987	37,701	35,127	41,434	40,427	38,231	48,728
18.		Mackerel	2,04,575	1,08,971	79,423	37,462	45,947	65,497	62,136	85,233	71,514	55,279	48,660
19.		Seer fish	18,339	21,210	19,700	19,841	18,897	20,159	21,119	20,779	29,547	25,986	27,553
20.		Tunnies	6,032	5,760	5,678	10,839	11,285	19,322	13,005	13,893	26,595	20,371	17,803
21.		*Sphyraena*	1,271	2,367	3,415	4,862	2,150	2,388	2,423	3,709	2,265	1,782	2,125
22.		*Mugil*	3,737	1,559	3,138	4,497	3,515	2,613	2,269	2,626	1,400	2,030	2,155
23.		*Bregmaceros*	4,345	5,488	4,213	1,872	1,043	380	30	184	638	916	464
24.		Soles	11,380	9,718	14,642	18,917	12,044	10,088	10,810	13,620	12,203	13,633	15,864
25.	a.	Penaeid prawns	72,109	78,361	1,36,514	1,14,934	1,41,713	1,14,640	96,472	1,29,204	1,13,665	1,12,037	83,539
	b.	Non-penaeid prawns	76,734	85,488	66,955	55,244	79,038	76,787	73,992	50,652	63,917	58,700	61,430
	c.	Lobsters	—	—	—	—	2,991	2,532	1,217	1,307	1,135	679	1,481
	d.	Crabs & other crustaceans	9,612	11,599	12,508	16,663	19,893	19,999	20,068	14,202	20,304	25,386	43,934
26.		Cephalopods	1,505	1,026	1,394	3,677	7,889	10,826	10,005	15,931	15,032	11,335	9,548
27.		Miscellaneous	37,513	48,598	56,266	72,718	97,607	90,812	91,945	1,13,582	1,06,250	65,840	52,288
		TOTAL	11,61,389	9,80,049	12,20,240	12,17,797	14,22,693	13,52,855	12,59,782	14,03,607	13,88,380	12,49,837	13,78,457

In Tables 4 to 17, for purpose of comparison with previous years, the following fishes have been included in the groups mentioned against them for the year 1981. (1) *Coilia* and *Setipinna* in other clupeoids and miscellaneous respectively. (2) Bill fishes in miscellaneous (3) Stomatopods in Crabs and other crustaceans.

Table 5. *Composition of marine fish landings in West Bengal during 1976 to 1981 (in tonnes)*

Sl.No.		Name of fish	1976	1977	1978	1979	1980	1981
1.		Elasmobranchs	493	73	125	244	114	594
2.		Eels	1	1	—	—	—	—
3.		Catfishes	785	134	151	140	723	4,449
4.		*Chirocentrus*	251	107	217	407	276	296
5.	a.	Oil sardine	—	—	—	—	—	—
	b.	Lesser sardines	12	—	4	—	—	—
	c.	*Hilsa ilisha*	799	96	193	660	644	2,672
	d.	Other *Hilsa*	—	—	28	38	20	44
	e.	*Anchoviella*	6	4	24	14	—	4
	f.	*Thrissocles*	1,397	365	774	270	194	66
	g.	Other clupeoids	1,790	705	1,174	1,517	674	2,652
6.	a.	*Harpodon nehereus*	2,253	1,060	1,365	1,211	419	618
	b.	*Saurida & Saurus*	—	—	—	—	—	—
7.		*Hemirhamphus & Belone*	—	—	11	—	—	1
8.		Flying fish	—	—	—	—	—	—
9.		Perches	1	—	—	225	13	37
10.		Red mullets	—	—	—	—	—	—
11.		Polynemids	69	25	87	172	186	312
12.		Sciaenids	4,066	819	1,772	915	358	270
13.		Ribbon fish	701	306	681	291	142	161
14.	a.	*Caranx*	—	—	2	71	—	—
	b.	*Chorinemus*	37	12	38	67	130	62
	c.	*Trachynotus*	—	—	—	—	—	—
	d.	Other carangids	—	—	—	—	—	—
	e.	*Coryphaena*	—	—	—	—	—	—
	f.	*Elacate*	—	—	—	—	—	—
15.	a.	*Leiognathus*	219	15	297	96	34	—
	b.	*Gazza*	—	—	—	—	—	—
16.		*Lactarius*	—	1	—	—	—	—
17.		Pomfrets	586	143	282	923	921	3,318
18.		Mackerel	—	—	—	—	—	—
19.		Seer fish	287	32	54	331	234	1,129
20.		Tunnies	—	—	—	—	—	—
21.		*Sphyraena*	—	—	—	—	—	—
22.		*Mugil*	2	—	—	—	—	1
23.		*Bregmaceros*	—	—	—	—	—	—
24.		Soles	—	—	24	—	3	4
25.	a.	Penaeid prawns	2,139	602	605	410	152	244
	b.	Non penaeid prawns	2,708	269	663	161	48	1,251
	c.	Lobsters	—	—	—	—	—	—
	d.	Other crustaceans	—	—	—	—	20	—
26.		Cephalopods	—	—	30	—	4	—
27.		Miscellaneous	6,809	1,920	4,153	2,581	788	1,922
		TOTAL	25,411	6,689	12,754	10,744	6,097	20,107

Table 6. *Composition of marine fish landings in West Bengal & Orissa during 1969 to 1975 (in tonnes)*

Sl.No.		Name of fish	1969	1970	1971	1972	1973	1974	1975
1.		Elasmobranchs	492	1,167	325	829	833	1,672	1,450
2.		Eels	—	—	8	24	43	84	4
3.		Catfishes	191	446	315	525	534	1,232	3,383
4.		*Chirocentrus*	1,025	1,163	464	334	737	565	687
5.	a.	Oil sardine	247	—	2	—	38	4	—
	b.	Lesser sardines	3,905	3,058	2,044	1,442	2,035	1,740	957
	c.	*Hilsa ilisha*	47	289	104	37	162	3,513	5,254
	d.	Other *Hilsa*	22	—	77	7	203	207	181
	e.	*Anchoviella*	900	510	316	673	768	362	207
	f.	*Thrissocles*	234	806	222	374	160	785	1,608
	g.	Other clupeoids	2,737	7,112	1,342	819	3,408	2,122	3,436
6.	a.	*Harpodon nehereus*	1,348	818	1,031	924	1,984	1,326	3,043
	b.	*Saurida & Saurus*	26	89	10	9	3	5	6
7.		*Hemirhamphus & Belone*	5	6	3	4	1	—	5
8.		Flying fish	—	—	—	—	—	—	—
9.		Perches	4	30	121	50	104	38	201
10.		Red mullets	34	—	5	10	4	20	14
11.		Polynemids	50	258	88	88	136	313	224
12.		Sciaenids	1,274	2,617	2,727	2,479	1,323	1,671	4,474
13.		Ribbon fish	581	1,470	825	530	902	550	1,252
14.	a.	*Caranx*	372	844	91	79	132	27	237
	b.	*Chorinemus*	100	91	70	74	172	212	165
	c.	*Trachynotus*	—	—	—	—	—	—	—
	d.	Other carangids	—	—	—	—	—	1	2
	e.	*Coryphaena*	—	—	—	—	—	—	—
	f.	*Elacate*	—	—	—	—	—	16	1
15.	a.	*Leiognathus*	937	891	317	921	438	399	552
	b.	*Gazza*	—	—	4	—	—	—	—
16.		*Lactarius*	5	58	8	29	7	24	6
17.		Pomfrets	423	426	643	634	728	1,110	2,501
18.		Mackerel	28	1,764	398	102	80	211	116
19.		Seer fish	612	826	338	329	769	1,169	554
20.		Tunnies	—	1	42	28	46	9	16
21.		*Sphyraena*	—	6	9	6	1	5	3
22.		*Mugil*	13	37	23	68	18	40	44
23.		*Bregmaceros*	—	—	—	—	—	—	—
24.		Soles	45	57	8	41	24	100	30
25.	a.	Penaeid prawns	5,638	2,994	1,314	1,471	2,565	2,322	2,920
	b.	Non penaeid prawns	—	22	86	—	486	1,165	2,787
	c.	Other crustaceans	—	3	1	3	60	45	8
26.		Cephalopods	2	3	89	7	7	—	2
27.		Miscellaneous	1,582	3,541	4,462	2,380	3,825	3,028	9,431
		TOTAL	22,879	31,403	18,032	15,330	22,736	26,092	45,761

Table 7. *Composition of marine fish landings in Orissa during 1976 to 1981 (in tonnes)*

Sl.No.		Name of Fish	1976	1977	1978	1979	1980	1981
1.		Elasmobranchs	2,974	1,658	3,386	4,331	3,772	3,210
2.		Eels	1	—	3	2	—	24
3.		Catfishes	1,988	1,035	1,794	1,308	2,198	6,084
4.		*Chirocentrus*	517	752	1,073	1,644	1,460	1,281
5.	a.	Oil sardine	—	—	—	—	—	—
	b.	Lesser sardines	1,657	1,227	2,514	2,687	1,891	4,535
	c.	*Hilsa ilisha*	5,477	2,948	7,737	9,969	5,091	2,085
	d.	Other *Hilsa*	129	492	848	359	46	353
	e.	*Anchoviella*	339	486	1,169	505	270	86
	f.	*Thrissocles*	106	197	175	295	333	322
	g.	Other clupeoids	772	778	1,330	1,431	2,576	2,093
6.	a.	*Harpodon nehereus*	87	86	314	449	378	73
	b.	*Saurida* & *Saurus*	1	5	5	50	189	108
7.		*Hemirhamphus* & *Belone*	1	—	13	28	46	2
8.		Flying fish	—	—	4	4	17	—
9.		Perches	31	55	173	151	341	122
10.		Red mullets	1	1	2	2	296	104
11.		Polynemids	244	406	1,287	1,491	1,126	566
12.		Sciaenids	333	312	5,198	5,351	2,864	2,133
13.		Ribbon fish	130	174	336	616	928	995
14.	a.	*Caranx*	147	103	68	326	607	165
	b.	*Chorinemus*	237	386	815	716	567	196
	c.	*Trachynotus*	—	—	—	—	—	
	d.	Other carangids	—	—	—	—	—	150
	e.	*Coryphaena*	2	1	—	1	—	
	f.	*Elacate*	—	9	3	1	—	
15.	a.	*Leiognathus*	378	233	256	1,108	704	733
	b.	*Gazza*	1	—	—	—	3	
16.		*Lactarius*	1	18	12	5	65	49
17.		Pomfrets	10,699	1,018	5,714	10,109	9,072	3,685
18.		Mackerel	425	195	196	306	265	823
19.		Seer fish	940	672	1,059	2,444	1,542	2,540
20.		Tunnies	84	37	609	31	34	250
21.		*Sphyraena*	1	3	4	5	8	9
22.		*Mugil*	5	—	3	22	1	—
23.		*Bregmaceros*	—	—	—	—	—	—
24.		Soles	6	72	103	125	69	47
25.	a.	Penaeid prawns	688	802	2,599	2,983	1,074	1,328
	b.	Non penaeid prawns	100	17	12	34	30	55
	c.	Lobsters	—	—	—	—	—	3
	d.	Other crustaceans	23	6	4	6	359	292
26.		Cephalopods	27	—	4	14	98	57
27.		Miscellaneous	1,271	888	848	2,899	1,055	1,097
		TOTAL	29,823	15,072	39,670	51,808	39,375	35,655

Table 8. *Composition of marine fish landings in Andhra Pradesh during 1971 to 1981 (in tonnes)*

Sl.No.		Name of fish	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
1.		Elasmobranchs	4,530	7,400	8,354	11,394	9,977	6,688	6,450	8,704	6,994	4,842	5,236
2.		Eels	107	110	270	451	1,837	205	438	1,082	245	289	406
3.		Catfishes	2,724	3,651	10,780	15,890	9,824	6,131	5,662	3,281	3,799	2,338	4,250
4.		*Chirocentrus*	1,439	2,248	2,635	2,281	2,920	1,837	1,217	1,262	976	1,123	1,111
5.	a.	Oil sardine	—	—	125	564	131	112	—	—	—	—	—
	b.	Lesser sardines	19,949	7,587	11,928	31,520	32,994	23,220	10,972	7,685	6,180	13,930	15,719
	c.	*Hilsa ilisha*	796	220	45	—	70	280	41	2	78	96	40
	d.	Other *Hilsa*	769	3,087	2,783	2,347	930	1,815	1,654	1,349	1,092	1,267	1,343
	e.	*Anchoviella*	1,332	2,005	4,865	9,869	7,037	11,309	8,947	7,810	5,888	6,182	13,829
	f.	*Thrissocles*	953	1,111	2,486	1,895	1,776	1,763	1,398	1,824	3,433	7,326	2,523
	g.	Other clupeoids	6,004	8,892	9,184	10,195	7,536	8,410	2,363	1,794	2,518	5,486	4,996
6.	a.	*Harpodon nehereus*	778	297	221	125	359	214	960	1,099	717	611	845
	b.	*Saurida & Saurus*	112	504	386	267	242	166	875	1,057	1,379	931	1,024
7.		*Hemirhamphus & Belone*	208	17	3	194	24	14	135	60	100	97	29
8.		Flying fish	247	52	105	2	1	—	84	65	71	43	—
9.		Perches	1,466	1,485	1,470	2,213	4,888	1,751	2,727	1,945	3,095	4,639	5,694
10.		Red mullets	372	447	220	305	721	553	315	335	426	349	684
11.		Polynemids	1,570	2,185	1,393	2,231	1,836	1,813	698	1,075	1,412	1,448	776
12.		Sciaenids	5,954	7,277	7,576	12,358	11,682	10,891	10,182	5,597	8,825	9,496	7,046
13.		Ribbon fish	7,432	3,585	3,761	11,834	11,701	12,443	8,546	5,505	6,337	15,646	8,207
14.	a.	*Caranx*	2,484	2,425	2,589	2,901	3,498	3,047	4,003	2,000	3,185	5,981	3,798
	b.	*Chorinemus*	533	552	1,056	1,620	1,790	1,820	530	665	444	710	453
	c.	*Trachynotus*	—	—	—	—	6	1	—	—	—	—	
	d.	Other carangids	15	—	—	—	6	5	78	87	56	97	1,415
	e.	*Coryphaena*	17	106	36	101	251	89	137	24	7	3	
	f.	*Elacate*	2	38	56	2	25	14	7	53	—	19	
15.	a.	*Leiognathus*	2,247	2,971	2,806	4,830	11,268	3,876	5,903	2,174	3,585	3,775	9,856
	b.	*Gazza*	—	1	3	12	101	48	—	—	—	56	
16.		*Lactarius*	841	1,396	982	1,914	2,513	1,718	1,132	684	945	940	817
17.		Pomfrets	3,591	4,165	4,087	3,945	5,697	4,088	2,529	2,445	2,069	2,201	2,698
18.		Mackerel	1,402	5,396	2,519	1,734	1,593	2,084	1,040	2,520	2,621	6,203	3,255
19.		Seer fish	3,352	5,830	4,054	4,438	5,277	3,412	3,261	2,600	5,547	2,970	3,563
20.		Tunnies	293	495	141	683	664	334	449	328	437	419	338
21.		*Sphyraena*	70	88	18	19	119	187	108	43	62	88	124
22.		*Mugil*	543	118	255	1,848	954	892	170	237	159	27	182
23.		*Bregmaceros*	—	—	—	—	—	—	—	—	—	—	—
24.		Soles	79	215	187	220	305	56	680	347	610	573	2,213
25.	a.	Penaeid prawns	8,917	5,145	8,170	9,857	7,152	8,833	6,266	8,031	8,697	5,660	6,728
	b.	Non penaeid prawns	288	437	669	2,842	3,523	2,275	5,109	1,532	3,117	4,346	1,607
	c.	Lobsters	—	—	—	—	102	3	2	20	33	10	1
	d.	Crabs & other crustaceans	95	279	364	934	605	329	719	477	1,109	1,413	1,800
26.		Cephalopods	114	67	61	165	151	242	408	297	523	470	512
27.		Miscellaneous	2,385	2,596	2,901	4,818	3,552	8,353	4,561	6,021	4,655	3,913	3,025
		TOTAL	84,010	84,480	99,544	1,58,818	1,55,638	1,31,321	1,00,756	82,116	91,426	1,16,013	1,16,143

Table 9. *Composition of marine fish landings in Tamil Nadu during 1971 to 1981 (in tonnes)*

Sl.No.	Name of fish	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
1.	Elasmobranchs	16,913	12,960	12,844	23,025	20,614	19,039	18,327	15,121	12,393	15,442	13,242
2.	Eels	147	47	121	296	110	620	232	325	119	85	93
3.	Catfishes	7,219	5,353	9,861	10,322	7,469	5,033	15,205	5,252	5,617	4,047	3,792
4.	*Chirocentrus*	2,952	2,320	3,178	1,625	1,811	2,058	2,475	1,736	1,839	2,695	1,820
5. a.	Oil sardine	45	146	45	—	—	—	714	36	1,011	320	195
b.	Lesser sardines	23,562	21,051	26,059	15,430	35,610	25,169	26,259	21,050	33,289	29,940	24,448
c.	*Hilsa Ilisha*	191	170	10	14	121	22	343	161	41	37	52
d.	Other *Hilsa*	2,804	2,088	1,349	681	1,158	2,331	5,784	4,166	2,761	3,084	3,516
e.	*Anchoviella*	5,162	4,378	9,105	10,745	10,873	7,869	13,388	7,447	11,061	13,126	8,357
f.	*Thrissocles*	4,968	5,278	4,821	4,645	3,127	8,362	3,008	4,719	5,542	5,048	6,465
g.	Other clupeoids	2,193	3,107	3,706	2,815	5,406	15,851	2,652	3,043	3,564	1,833	5,241
6. a.	*Harpodon nehereus*	13	48	235	—	1	—	14	—	1	6	3
b.	*Saurida & Saurus*	1,395	923	871	1,196	1,026	823	572	1,100	1,498	1,123	1,455
7.	*Hemirhamphus & Belone*	492	403	675	3,949	1,482	717	1,574	759	624	749	819
8.	Flying fish	8,375	1,290	6,221	726	1,657	1,232	526	1,092	1,599	1,106	2,460
9.	Perches	5,743	6,350	4,914	8,426	8,153	5,341	7,918	9,241	5,919	6,886	6,453
10.	Red mullets	1,268	1,311	1,010	1,959	1,566	626	832	1,963	1,448	1,079	1,116
11.	Polynemids	1,615	906	1,806	877	1,339	1,944	1,592	706	353	629	236
12.	Sciaenids	5,495	6,221	10,607	9,943	10,096	10,562	13,756	14,239	18,948	19,547	13,140
13.	Ribbon fish	10,897	10,498	9,625	8,369	17,782	19,054	4,594	28,664	21,040	7,862	7,605
14. a.	*Caranx*	8,486	7,109	5,624	5,188	6,225	7,082	6,120	3,104	7,022	5,405	1,281
b.	*Chorinemus*	1,343	1,045	843	1,541	1,090	646	1,465	971	844	1,111	608
c.	*Trachynotus*	11	—	—	2	—	28	73	84	182	38	12,735
d.	Other carangids	24	29	9	2	8	907	22	171	23	188	
e.	*Coryphaena*	41	24	32	77	65	105	58	18	37	141	
f.	*Elacate*	31	280	75	101	87	217	230	239	535	148	
15. a.	*Leiognathus*	18,913	21,564	22,133	23,906	20,142	29,664	17,783	30,281	42,886	38,153	50,942
b.	*Gazza*	5	62	34	28	29	6	54	104	197	84	
16.	*Lactarius*	640	1,348	2,823	722	1,822	775	740	840	1,323	938	818
17.	Pomfrets	834	461	1,705	720	1,303	822	628	789	877	1,306	670
18.	Mackerel	2,983	7,838	8,843	2,639	5,826	10,488	5,674	1,453	3,521	7,229	3,916
19.	Seer fish	5,032	6,010	5,763	5,178	4,100	3,784	6,424	4,700	5,228	7,179	5,431
20.	Tunnies	1,044	658	624	1,691	1,785	2,923	3,238	1,169	3,211	4,233	3,820
21.	*Sphyraena*	875	997	858	800	1,506	1,554	1,702	2,147	1,463	932	948
22.	*Mugil*	817	266	1,449	261	1,566	285	923	829	229	577	409
23.	*Bregmaceros*	—	—	—	—	—	—	—	—	—	—	—
24.	Soles	689	518	683	1,247	785	909	908	1,580	2,337	2,094	1,431
25. a.	Penaeid prawns	3,637	4,885	4,504	8,060	11,460	8,864	8,197	13,327	10,222	9,082	13,548
b.	Non penaeid prawns	62	148	1,285	46	573	169	159	585	897	946	704
c.	Lobsters	—	—	—	—	465	525	286	249	340	90	238
d.	Crabs & other crustaceans	6,059	9,518	7,719	9,752	13,896	16,413	11,018	9,290	5,883	6,174	9,485
26.	Cephalopods	389	248	426	955	2,953	1,451	1,375	1,042	1,903	1,472	1,687
27.	Miscellaneous	7,255	7,297	9,924	7,754	16,128	11,808	19,204	19,107	17,181	15,230	12,117
	TOTAL	1,60,619	1,55,153	1,82,419	1,75,713	2,21,215	2,26,078	2,06,046	2,12,899	2,35,008	2,17,394	2,21,296

Table 10. *Composition of marine fish landings in Pondicherry* during 1971 *to* 1981 *(in tonnes)*

Sl.No.	Name of fish	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
1.	Elasmobranchs	848	492	322	186	129	165	352	199	222	435	387
2.	Eels	103	1	2	3	4	6	5	—	88	8	13
3.	Catfishes	360	72	122	65	55	66	137	168	51	78	102
4.	*Chirocentrus*	277	153	291	58	50	63	63	111	167	98	85
5. a.	Oil sardine	—	—	—	—	—	—	—	—	—	—	—
b.	Lesser sardines	1,807	724	500	1,203	1,046	1,839	1,156	1,184	1,998	2,736	1,342
c.	*Hilsa ilisha*	5	—	—	—	31	—	—	—	—	25	—
d.	Other *Hilsa*	159	93	157	173	277	121	43	108	12	53	129
e.	*Anchoviella*	697	439	695	692	412	178	548	521	346	287	507
f.	*Thrissocles*	338	442	619	519	337	565	405	258	429	387	520
g.	Other clupeoids	106	141	66	71	50	1	—	281	345	273	400
6. a.	*Harpodon nehereus*	—	—	—	—	—	—	—	—	—	—	—
b.	*Saurida & Saurus*	276	122	103	26	44	105	103	132	262	160	246
7.	*Hemirhamphus & Belone*	26	3	—	21	55	2	4	—	6	26	57
8.	Flying fish	492	42	18	110	142	165	3	480	854	3	614
9.	Perches	510	277	405	132	389	769	391	487	1,004	666	932
10.	Red mullets	132	66	121	76	100	77	32	109	203	150	155
11.	Polynemids	16	15	20	25	14	26	5	27	14	6	1
12.	Sciaenids	391	546	626	250	212	434	258	374	306	320	330
13.	Ribbon fish	96	402	434	236	314	428	143	139	129	179	217
14. a.	*Caranx*	1,004	311	227	472	610	501	490	218	537	479	162
b.	*Chorinemus*	22	—	—	2	—	2	5	33	27	2	32
c.	*Trachynotus*	—	—	—	—	—	—	—	—	—	2	
d.	Other carangids	—	—	—	—	—	—	—	—	—	—	1,507
e.	*Coryphaena*	—	—	3	5	—	7	2	3	2	—	
f.	*Elacate*	7	—	—	—	—	—	1	—	—	—	
15. a.	*Leiognathus*	593	412	546	249	511	482	318	372	746	681	975
b.	*Gazza*	—	—	—	—	—	—	7	—	—	—	
16.	*Lactarius*	53	17	2	12	30	121	175	—	11	29	44
17.	Pomfrets	48	67	82	24	13	44	53	50	35	188	123
18.	Mackerel	650	3,317	2,649	2,317	2,259	1,598	398	179	424	445	316
19.	Seer fish	76	25	46	68	23	28	34	41	105	85	101
20.	Tunnies	16	1	—	9	—	1	—	3	1	—	55
21.	*Sphyraena*	97	3	1	28	27	15	9	25	22	55	50
22.	*Mugil*	7	15	19	1	31	4	14	26	27	49	5
23.	*Bregmaceros*	—	—	—	—	—	—	—	—	—	—	—
24.	Soles	119	65	214	48	125	254	78	109	162	151	194
25. a.	Penaeid prawns	289	177	33	27	62	93	103	245	532	485	336
b.	Non penaeid prawns	1	5	8	2	2	—	2	71	72	42	53
c.	Lobsters	—	—	—	—	25	33	20	2	5	4	5
d.	Crabs & other crustaceans	178	408	194	201	260	516	296	251	242	172	236
26.	Cephalopods	52	22	20	28	58	211	62	36	50	40	44
27.	Miscellaneous	603	105	137	359	453	1,203	747	586	632	591	480
	TOTAL	10,454	8,980	8,682	7,698	8,150	10,123	6,462	6,828	10,068	9,390	10,755

Table 11. *Composition of marine fish landings in Kerala during 1971 to 1981 (in tonnes)*

Sl.No.	Name of fish	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
1.	Elasmobranchs	4,889	6,986	8,852	10,338	10,292	7,308	5,796	9,302	6,954	6,803	4,871
2.	Eels	31	5	3	49	12	10	6	38	10	6	3
3.	Catfishes	15,189	12,636	17,438	33,526	32,603	12,743	7,947	9,125	11,328	13,936	9,562
4.	*Chirocentrus*	464	397	544	860	605	807	547	1,298	1,125	1,002	973
5. a.	Oil sardine	1,94,977	1,04,426	1,22,783	1,02,135	97,183	1,23,937	1,17,356	1,19,937	1,16,834	69,667	1,46,986
b.	Lesser sardines	11,403	6,790	62,421	31,335	33,652	34,305	20,754	11,713	15,914	11,017	7,629
c.	*Hilsa ilisha*	9	19	—	—	10	12	36	182	6	14	8
d.	Other *Hilsa*	6	3	39	33	—	—	14	69	36	21	15
e.	*Anchoviella*	10,842	10,672	8,940	19,463	11,432	9,987	10,105	21,203	6,552	7,772	4,293
f.	*Thrissocles*	2,349	2,001	1,663	1,321	1,638	2,732	1,648	1,898	1,789	2,241	634
g.	Other clupeoids	1,668	1,346	1,158	1,323	998	1,174	512	973	674	574	944
6. a.	*Harpodon nehereus*	1	43	45	18	—	—	—	21	1	—	—
b.	*Saurida & Saurus*	1,395	1,426	1,136	8,839	11,294	99	5,169	6,246	5,326	7,080	5,691
7.	*Hemirhamphus & Belone*	97	88	185	331	278	141	281	281	257	361	565
8.	Flying fish	2	—	1	2	—	1	—	—	—	—	16
9.	Perches	3,663	3,939	8,663	20,970	14,741	3,069	14,121	24,989	20,239	17,814	8,549
10.	Red mullets	1,573	2,960	1,537	3,881	23	2,577	240	171	127	1	33
11.	Polynemids	569	24	570	3	105	122	69	35	29	8	47
12.	Sciaenids	4,145	6,137	11,723	9,220	16,811	6,955	11,965	13,045	5,237	6,164	3,145
13.	Ribbon fish	17,380	10,459	23,897	30,192	15,175	7,687	7,440	24,207	25,718	12,937	7,066
14. a.	*Caranx*	4,952	14,848	14,283	5,260	7,190	10,478	15,673	7,197	12,339	4,399	1,743
b.	*Chorinemus*	49	817	48	72	135	265	540	148	128	145	318
c.	*Trachynotus*	6	2	—	—	6	—	7	19	—	—	
d.	Other carangids	3	36	36	73	85	6	78	72	—	59	2,989
e.	*Coryphaena*	1	92	153	94	61	56	28	19	48	138	
f.	*Elacate*	299	76	52	35	62	106	158	166	120	19	
15. a.	*Leiognathus*	8,609	5,042	18,388	17,518	5,211	2,727	7,708	3,040	3,597	4,147	2,826
b.	*Gazza*	21	15	4	5	—	—	—	—	—	1	
16.	*Lactarius*	2,991	3,034	6,663	2,904	983	468	823	1,533	253	861	879
17.	Pomfrets	2,416	1,932	1,809	1,500	1,181	799	3,712	1,614	1,737	907	1,373
18.	Mackerel	95,164	34,516	19,780	10,335	14,930	19,978	19,968	25,917	18,585	18,474	16,200
19.	Seer fish	2,800	1,386	1,690	4,909	4,065	5,936	3,250	3,354	6,275	3,763	3,330
21.	Tunnies	3,043	3,626	2,699	5,927	5,845	12,880	6,705	6,548	15,391	10,611	5,509
21.	*Sphyraena*	174	1,125	2,333	3,865	396	494	353	721	477	330	812
22.	*Mugil*	549	91	103	955	74	26	38	1	39	151	120
23.	Bregmaceros	—	—	—	—	—	—	—	—	—	—	—
24.	Soles	8,807	6,119	8,551	12,771	6,932	3,567	5,778	7,276	4,487	4,394	5,034
25. a.	Penaeid prawns	31,294	35,866	84,770	59,815	77,207	34,478	40,150	45,034	29,522	52,633	22,268
b.	Non penaeid prawns	1,519	711	981	1,014	755	55	174	394	75	1,742	160
c.	Lobsters	—	—	—	—	31	50	40	38	26	18	50
d.	Crabs & other crustaceans	523	158	1,781	2,886	1,797	1,316	4,621	2,176	7,643	7,286	2,998
26.	Cephalopods	473	350	339	2,175	3,342	872	4,973	6,516	2,976	4,244	2,376
27.	Miscellaneous	11,002	15,419	12,208	14,305	43,696	22,824	26,254	16,823	8,635	7,803	4,380
	TOTAL	4,45,347	2,95,618	4,48,269	4,20,257	4,20,836	3,31,047	3,45,037	3,73,339	3,30,509	2,79,543	2,74,395

Table 12. *Composition of marine fish landings in Karnataka during 1971 to 1981 (in tonnes)*

Sl.No.	Name of fish	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
1.	Elasmobranchs	2,753	4,587	1,690	2,007	1,726	1,489	3,238	2,051	2,531	2,910	4,065
2.	Eels	—	8	8	8	81	—	3	8	1	131	—
3.	Catfishes	1,331	3,184	2,372	2,011	3,222	4,279	5,162	2,831	9,920	5,354	7,503
4.	*Chirocentrus*	176	343	219	684	412	184	717	247	258	171	118
5. a.	Oil sardine	11,836	15,610	15,495	20,784	52,701	41,451	31,145	46,707	33,080	42,727	65,614
b.	Lesser sardines	491	1,563	1,164	228	775	641	180	2,572	4,753	4,135	5,328
c.	*Hilsa ilisha*	18	785	50	459	1	—	44	9	10	8	1
d.	Other *Hilsa*	14	5	33	1	10	30	113	30	52	25	331
e.	*Anchoviella*	97	124	235	51	10	54	174	443	1,721	5,621	5,959
f.	*Thrissocles*	180	575	263	1,079	344	900	831	919	441	850	296
g.	Other clupeoids	365	698	690	957	568	457	1,677	872	2,278	1,088	951
6. a.	*Harpodon nehereus*	10	1	17	5	2	7	4	4	5	15	—
b.	*Saurida & Saurus*	351	18	—	3	75	187	385	92	155	508	333
7.	*Hemirhamphus & Belone*	38	27	18	5	36	87	57	41	49	180	148
8.	Flying fish	—	1	—	—	—	—	—	—	—	55	—
9.	Perches	132	177	122	203	727	454	1,489	174	181	1,069	399
10.	Red mullets	9	65	3	—	3	145	19	31	30	38	—
11.	Polynemids	1	69	8	16	3	—	3	3	2	—	—
12.	Sciaenids	1,313	2,114	1,013	3,208	1,853	3,216	2,762	1,728	2,348	3,500	2,295
13.	Ribbon fish	330	748	138	303	219	583	237	404	1,193	1,499	235
14. a.	*Caranx*	440	516	1,226	771	746	656	760	202	1,103	4,507	1,012
b.	*Chorinemus*	5	286	12	72	55	80	506	13	59	67	148
c.	*Trachynotus*	—	—	—	115	49	—	—	3	13	—	
d.	Other carangids	—	—	—	11	92	—	41	43	1	232	2,429
e.	*Coryphaena*	—	—	—	—	23	—	—	—	—	—	
f.	*Elacate*	8	3	220	54	31	32	1	55	34	3	
15. a.	*Leiognathus*	1,321	795	2,659	2,058	1,240	4,086	1,631	4,241	1,565	4,671	1,638
b.	*Gazza*	—	—	—	—	—	—	—	—	—	42	
16.	*Lactarius*	487	899	1,740	1,546	495	216	101	198	433	998	515
17.	Pomfrets	866	618	1,153	303	213	438	249	1,957	250	696	419
18.	Mackerel	64,047	32,249	35,468	9,696	12,469	22,455	26,214	50,704	40,084	19,634	19,766
19.	Seer fish	2,506	2,498	1,313	1,532	776	1,341	1,831	1,463	1,645	1,941	2,267
20.	Tunnies	515	134	124	394	212	576	622	614	1,717	952	2,517
21.	*Sphyraena*	21	32	130	26	14	9	3	276	41	84	75
22.	*Mugil*	—	12	33	—	8	6	—	1	—	39	1
23.	*Bregmaceros*	—	—	—	—	—	—	—	—	—	—	—
24.	Soles	656	1,594	626	2,377	373	637	985	1,820	874	782	545
25. a.	Penaeid prawns	4,420	8,058	8,235	12,695	3,074	2,594	3,335	8,422	4,654	3,098	4,122
b.	Non penaeid prawns	—	17	1	1	—	—	—	18	6	128	4
c.	Lobsters	—	—	—	—	12	8	4	39	15	110	—
d.	Crabs & other crustaceans	1,763	346	934	1,742	2,540	156	207	741	2,740	2,765	9,368
26.	Cephalopods	7	25	19	20	175	3,067	965	1,346	68	122	266
27.	Miscellaneous	7,217	13,892	14,053	10,838	2,129	4,762	11,457	21,538	12,074	4,567	14,681
	TOTAL	1,03,724	92,676	91,484	76,263	87,494	95,283	97,152	1,52,860	1,26,384	1,15,322	1,53,349

perches, ribbon fish, tunnies, catfish, white baits, lesser sardines and croakers, the reduction being 9,300, 5,900, 5,100, 4,400, 3,500, 3,400 and 3,000 t respectively. Table 11 shows the species composition of marine fish landings in Kerala for the period 1971 to 1981.

Karnataka

In Karnataka, the total marine fish landings showed a substantial increase of about 38,000 t (33%) during 1981 as compared to 1980. The catch of oil sardine increased significantly by about 23,000 t contributing substantially to the increase in the total catch of the state. The landings of catfishes, tunnies, lesser sardines and penaeid prawns also increased by about 2,100, 1,600, 1,200 and 1,000 t respectively. The catch of silverbellies, ribbon fish, croakers and perches, however, showed a decline of about 3,000, 1,300, 1,200 and 700 t respectively. The specieswise composition of total marine fish production in Karnataka during the years 1971 to 1981 is given in Table 12.

Goa

An increase of about 10,000 t (41%) in the total landings was noticed during 1981 as compared to 1980. While the landings of oil sardine, mackerel, catfishes and perches increased by about 5,200, 1,500, 1,100 and 900 t respectively, ribbon fish catch showed a decline of about 400 t. Table 13 shows the details of specieswise composition of total marine fish landings in Goa during the years 1971 to 1981.

Maharashtra

The total marine fish catch in Maharashtra during 1981 was estimated at 2.73 lakh t. The important fisheries of the state viz. Bombay duck, non-penaeid prawns, penaeid prawns, croakers, pomfrets and

Table 13. *Composition of marine fish landings in Goa during* 1971 *to* 1981 *(in tonnes)*

Sl. No.	Name of fish	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
1.	Elasmobranchs	229	299	199	387	572	1,038	625	863	1,280	894	1,050
2.	Eels	—	—	—	—	64	1	—	55	35	6	19
3.	Catfishes	84	281	230	348	1,367	834	918	1,356	846	1,151	2,211
4.	*Chirocentrus*	13	21	34	78	32	54	32	78	122	124	181
5. a.	Oil sardine	1,994	3,793	3,426	2,106	7,526	1,385	807	1,398	3,030	2,367	7,609
b.	Lesser sardines	72	2,165	1,272	1,172	3,914	11,100	4,066	5,151	2,471	1,798	2,296
c.	*Hilsa ilisha*	—	—	—	—	—	—	—	3	2	8	2
d.	Other *Hilsa*	—	—	—	—	—	—	1	2	14	14	26
e.	*Anchoviella*	44	123	146	—	31	—	9	5	—	249	108
f.	*Thrissocles*	—	—	—	81	123	290	293	1,308	911	779	593
g.	Other clupeoids	260	8	120	276	419	667	520	645	378	302	341
6. a.	*Harpodon nehereus*	2	—	—	—	10	46	20	27	9	12	1
b.	*Saurida & Saurus*	—	—	—	1	151	25	239	279	104	199	707
7.	*Hemirhamphus & Belone*	—	—	—	—	—	8	13	56	13	6	2
8.	Flying fish	—	—	—	—	—	—	—	2	1	2	—
9.	Perches	—	26	4	9	45	310	505	781	203	269	1,183
10.	Red mullets	—	—	6	34	77	—	—	—	—	15	60
11.	Polynemids	15	13	13	44	63	—	1	1	—	10	14
12.	Sciaenids	106	280	171	883	3,048	2,640	2,779	3,256	1,492	1,530	1,610
13.	Ribbon fish	23	12	48	111	355	1,123	449	504	548	1,089	684
14. a.	*Caranx*	—	4	2	952	1,078	794	1,149	1,803	1,343	884	113
b.	*Chorinemus*	—	—	—	4	—	100	44	56	140	71	44
c.	*Trachynotus*	—	—	—	—	—	3	—	—	—	—	
d.	Other carangids	—	—	—	—	—	—	—	—	—	—	565
e.	*Coryphaena*	—	—	—	—	—	—	—	—	—	—	
f.	*Elacate*	—	—	—	—	—	—	23	52	190	190	
15. a.	*Leiognathus*	156	287	152	1,420	604	896	458	704	881	1,727	2,075
b.	*Gazza*	—	—	—	—	—	3	—	—	—	—	
16.	*Lactarius*	5	113	170	373	189	338	375	443	291	614	820
17.	Pomfrets	24	31	24	96	102	100	296	367	138	257	123
18.	Mackerel	35,258	19,999	7,616	7,905	6,779	6,448	7,661	3,371	4,391	2,446	3,939
19.	Seer fish	108	67	66	273	222	501	213	691	1,101	735	643
20.	Tunnies	—	—	—	—	2	23	107	300	742	356	188
21.	*Sphyraena*	—	—	—	—	—	—	—	7	7	171	38
22.	*Mugil*	—	18	—	5	124	4	46	32	14	11	206
23.	*Bregmaceros*	—	—	—	—	—	—	—	—	—	—	—
24.	Soles	64	221	95	196	16	137	335	417	893	1,311	727
25. a.	Penaeid prawns	279	561	785	1,448	1,762	4,643	1,436	1,647	1,594	1,853	2,237
b.	Non penaeid prawns	—	—	—	—	—	—	24	26	—	—	—
c.	Lobsters	—	—	—	—	6	3	7	13	6	18	9
d.	Crabs & other crustaceans	11	7	20	86	227	971	637	531	1,379	1,933	2,696
26.	Cephalopods	—	5	—	14	96	142	164	124	173	210	94
27.	Miscellaneous	1,233	1,770	1,141	1,232	166	341	479	757	646	879	1,284
	TOTAL	39,980	30,104	15,740	19,534	29,170	34,968	24,731	27,111	25,388	24,490	34,498

Table 14. *Composition of marine fish landings in Maharashtra during 1971 to 1981 (in tonnes)*

Sl.No.		Name of fish	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
1.		Elasmobranchs	4,470	5,937	7,624	6,538	8,167	7,089	7,746	10,072	12,516	7,752	9,675
2.		Eels	2,864	3,190	2,026	674	1,101	4,168	3,849	5,384	4,033	3,154	2,290
3.		Catfishes	18,052	12,821	9,226	7,240	8,236	9,522	8,318	11,081	10,433	8,653	11,045
4.		*Chirocentrus*	1,207	1,268	2,152	1,135	2,936	2,409	2,634	3,059	1,721	2,039	2,918
5.	a.	Oil sardine	407	3,593	2,483	1,083	1,699	2,377	108	—	16	663	622
	b.	Lesser sardines	1,864	2,877	3,077	1,238	3,103	1,963	1,024	868	927	1,363	420
	c.	*Hilsa ilisha*	22	13	89	4	16	154	352	1,558	1,071	1,017	530
	d.	Other *Hilsa*	1,121	1,399	849	800	1,152	661	978	466	429	607	2,201
	e.	*Anchoviella*	990	209	573	272	533	209	269	340	382	78	55
	f.	*Thrissocles*	1,574	1,236	3,008	869	927	1,276	1,679	1,821	2,832	1,271	944
	g.	Other clupeoids	8,781	9,484	15,018	13,892	21,172	16,944	22,782	13,608	15,675	16,897	20,314
6.	a.	*Harpodon nehereus*	33,993	21,246	34,179	29,989	51,645	49,470	50,803	68,781	59,667	57,393	82,136
	b.	*Saurida & Saurus*	148	577	987	637	218	1,089	1,135	1,815	2,374	1,057	1,308
7.		*Hemirhamphus & Belone*	127	108	117	33	52	30	32	51	126	42	46
8.		Flying fish	49	13	1	2	2	—	—	5	1	—	—
9.		Perches	853	1,379	3,195	2,111	2,484	1,460	2,973	6,951	3,225	3,712	2,617
10.		Red mullets	514	1,133	987	701	103	497	171	344	859	461	982
11.		Polynemids	987	2,174	2,333	1,797	1,628	4,125	862	1,909	1,600	1,976	711
12.		Sciaenids	13,339	11,299	14,319	17,453	20,576	19,781	17,086	17,202	21,366	13,956	17,475
13.		Ribbon fish	6,562	8,544	13,363	9,585	9,435	10,052	6,338	10,400	10,983	11,550	8,048
14.	a.	*Caranx*	2,280	1,371	804	2,535	2,240	1,179	1,167	1,899	2,314	1,315	135
	b.	*Chorinemus*	87	171	445	179	145	121	230	300	416	357	360
	c.	*Trachynotus*	—	—	189	5	3	3	—	—	—	—	
	d.	Other carangids	134	29	84	4	—	654	—	50	385	369	1,014
	e.	*Coryphaena*	—	—	4	9	11	2	—	—	51	20	
	f.	*Elacate*	—	6	126	21	15	—	—	—	—	—	
15.	a.	*Leiognathus*	231	268	955	473	200	—	358	323	724	406	129
	b.	*Gazza*	126	—	—	293	293	—	—	—	—	—	
16.		*Lactarius*	288	322	760	431	431	643	247	836	430	450	500
17.		Pomfrets	5,787	6,858	8,209	6,683	8,351	17,979	17,295	13,050	14,941	10,081	17,144
18.		Mackerel	4,650	5,507	2,368	2,587	1,860	1,944	875	787	1,455	288	289
19.		Seer fish	1,509	2,089	1,769	1,434	1,850	2,116	3,220	2,915	4,027	3,219	2,814
20.		Tunnies	292	294	743	286	274	463	312	1,939	1,772	1,674	1,248
21.		*Sphyraena*	—	54	21	21	17	50	—	388	82	33	16
22.		*Mugil*	72	55	65	22	30	191	48	102	38	24	35
23.		*Bregmaceros*	4,345	5,488	4,213	1,806	1,043	380	30	21	276	159	13
24.		Soles	904	553	2,737	502	487	1,553	1,245	1,676	2,304	1,797	1,784
25.	a	Penaeid prawns	18,974	20,173	16,894	14,712	24,653	40,772	26,675	41,091	45,638	23,433	21,717
	b.	Non penaeid prawns	74,637	83,952	63,455	50,025	69,012	63,702	66,978	44,255	56,208	47,309	52,854
	c.	Lobsters	—	—	—	—	245	419	434	607	499	225	388
	d.	Crabs & other crustaceans	979	487	687	973	550	51	93	148	519	297	496
26.		Cephalopods	368	282	501	298	482	2,488	596	4,557	3,959	1,191	1,755
27.		Miscellaneous	1,718	3,543	6,061	5,609	9,242	25,615	15,510	13,585	7,052	5,475	5,559
		TOTAL	2,15,305	2,20,002	2,26,696	1,84,961	2,56,619	2,93,601	2,64,452	2,84,244	2,93,326	2,31,763	2,72,587

Table 15. *Composition of marine fish landings in Gujarat during 1971 to 1981 (in tonnes)*

Sl.No.		Name of fish	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
1.		Elasmobranchs	6,249	6,572	3,995	10,227	11,930	7,896	17,565	11,511	4,926	14,558	13,433
2.		Eels	796	1,124	1,396	2,446	2,497	3,283	8,463	1,886	2,622	8,403	2,179
3.		Catfishes	3,570	3,905	2,071	5,548	2,514	2,140	8,958	4,159	5,320	5,235	10,370
4.		*Chirocentrus*	2,363	2,435	1,295	1,722	2,325	2,155	3,327	1,869	1,970	3,792	2,986
5.	a.	Oil sardine	—	—	—	—	—	—	—	—	—	—	—
	b.	Lesser sardines	43	368	—	—	—	8	—	—	—	—	—
	c.	*Hilsa ilisha*	624	165	48	258	3,394	1,098	329	49	231	56	17
	d.	Other *Hilsa*	5,405	5,536	6,500	3,292	3,846	3,367	5,547	5,703	3,837	3,965	10,283
	e.	*Anchoviella*	—	9	—	—	130	—	—	—	—	—	—
	f.	*Thrissocles*	217	113	174	239	117	269	105	608	686	913	1,274
	g.	Other clupeoids	3,372	3,983	1,995	11,557	13,192	11,098	9,458	13,282	5,552	8,538	7,067
6.	a.	*Harpodon nehereus*	35,680	29,011	27,664	29,675	44,554	34,998	32,289	53,870	63,984	36,671	54,114
	b.	*Saurida & Saurus*	—	1,169	563	1,546	1,267	2,797	42	82	6	85	110
7.		*Hemirhamphus & Belone*	1	5	2	5	3	101	104	1	185	6	—
8.		Flying fish	—	—	—	127	—	—	—	—	—	—	—
9.		Perches	383	1,394	2,403	2,462	3,261	4,641	1,213	4,174	973	2,454	4,832
10.		Red mullets	—	—	1	1	—	680	779	2	8	—	294
11.		Polynemids	2,391	1,626	2,969	5,331	8,832	6,230	268	339	736	667	1,585
12.		Sciaenids	3,433	3,806	40,324	24,275	45,781	28,698	39,968	33,968	28,230	31,625	35,242
13.		Ribbon fish	1,145	1,447	938	1,849	1,097	12,341	14,180	6,944	4,491	10,858	8,327
14.	a.	*Caranx*	771	229	242	1,068	1,012	1,642	1,002	270	510	461	757
	b.	*Chorinemus*	—	7	251	95	—	14	401	320	466	1,022	2,764
	c.	*Trachynotus*	—	—	—	—	—	—	—	—	—	—	
	d.	Other carangids	128	214	—	—	14	—	—	—	—	—	89
	e.	*Coryphaena*	—	—	—	—	—	—	—	—	—	—	
	f.	*Elacate*	—	—	—	—	—	14	—	—	—	—	
15.	a.	*Leiognathus*	82	—	—	2	1	908	—	—	—	—	—
	b.	*Gazza*	—	—	—	—	—	—	—	—	—	—	—
16.		*Lactarius*	—	421	765	987	5,379	7,765	7,349	3,360	783	2,520	3,769
17.		Pomfrets	6,781	4,234	4,249	8,029	5,612	2,116	9,174	15,141	9,319	12,587	19,169
18.		Mackerel	1	—	—	—	—	—	—	—	35	112	—
19.		Seer fish	2,524	2,850	4,110	686	1,879	1,634	2,022	3,734	2,682	4,180	5,536
20.		Tunnies	1	1	268	579	546	734	332	451	442	277	1,600
21.		*Sphyraena*	—	36	29	54	26	9	154	—	—	—	1
22.		*Mugil*	1,674	847	1,116	1,291	600	1,097	900	1,264	751	1,034	1,118
23.		*Bregmaceros*	—	—	—	66	—	—	—	163	362	757	451
24.		Soles	54	392	1,525	1,456	2,991	2,969	729	268	411	2,459	3,885
25.	a.	Penaeid prawns	2,873	2,013	10,550	5,970	13,395	11,497	8,861	7,938	8,606	14,481	10,985
	b.	Non penaeid prawns	141	218	70	149	2,386	7,778	1,260	3,096	3,347	4,109	4,742
	c.	Lobsters	—	—	—	39	2,105	1,491	424	339	211	204	786
	d.	Crabs & other crustaceans	3	393	749	5	10	224	2,471	584	783	4,967	16,549
26.		Cephalopods	—	3	1	7	611	2,286	1,439	1,959	5,351	3,471	2,743
27.		Miscellaneous	1,454	1,320	5,700	24,266	12,468	7,316	10,525	24,595	33,496	23,027	7,453
		TOTAL	82,159	75,846	1,21,963	1,45,309	1,93,775	1,71,294	1,89,638	2,01,929	1,91,312	2,03,494	2,34,510

catfishes landed about 30, 20, 8, 6, 6, and 4 per cent respectively of the total catch (Table 4).

Gujarat

In Gujarat, the total marine fish landings increased by about 31,000 t (15%) during 1981 as compared to 1980. Bombay duck, the major fishery of this state, showed an increase in the catch by about 17,400 t. The other species that showed increase in their landings were other crustaceans, pomfrets, catfishes, croakers, perches and carangids, the improvement being 11,600, 6,600, 5,100, 3,600, 2,400 and 2,100 t respectively. The catch of eels, penaeid prawns and ribbon fish showed a decline of about 6,200, 3,500 and 2,500 t respectively. Table 15 shows the specieswise composition of total marine fish landings in Gujarat for the years 1971 to 1981.

Andamans

A marginal increase of about 60 t (3%) in the total catch was noticed during 1981 as compared to 1980. While catches of silverbellies and whitebaits increased by 170 and 90 t respectively, the catch of perches showed a decline of about 110 t. The specieswise composition of total marine fish catch in Andamans for the years 1971 to 1981 is shown in Table 16.

Lakshadweep

The total marine fish catch in Lakshadweep showed a marginal increase of about 400 t (13%) during 1981. This is mainly due to higher landings of tunnies which showed an increase of about 500 t. Elasmobranchs and perches, however, showed a decline of about 100 and 60 t respectively. Table 17 shows the specieswise

Table 16. *Composition of marine fish landings in Andamans during* 1971 *to* 1981 *(in tonnes)*

Sl.No.	Name of fish	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
1.	Elasmobranchs	22	18	33	27	48	72	90	89	88	56	35
2.	Eels	—	—	—	—	—	1	—	—	—	—	—
3.	Catfishes	14	15	8	14	15	19	28	33	55	32	22
4.	*Chirocentrus*	11	13	5	18	35	33	38	40	45	25	25
5. a.	Oil sardine	—	—	—	—	—	—	—	—	—	—	—
b.	Lesser sardines	48	62	67	55	66	86	86	97	132	243	263
c.	*Hilsa ilisha*	—	—	—	—	—	—	—	—	—	—	—
d.	Other *Hilsa*	6	11	5	7	13	28	25	31	42	25	26
e.	*Anchoviella*	36	67	67	53	79	118	103	92	119	99	185
f.	*Thrissocles*	—	—	—	—	—	—	—	—	—	—	—
g.	Other clupeoids	9	12	5	18	9	—	11	18	33	29	—
6. a.	*Harpodon nehereus*	—	—	—	—	—	—	—	—	—	—	—
b.	*Saurida & Saurus*	—	—	—	—	—	—	—	—	—	—	—
7.	*Hemirhamphus & Belone*	17	13	10	9	16	35	53	61	88	41	17
8.	Flying fish	—	—	—	—	—	—	—	—	—	—	3
9.	Perches	79	87	103	114	157	142	196	234	239	302	192
10.	Red mullets	—	—	—	—	—	2	4	—	—	—	—
11.	Polynemids	—	—	—	—	—	—	—	—	—	—	—
12.	Sciaenids	—	—	—	—	—	5	—	—	—	—	—
13.	Ribbon fish	—	—	—	—	—	—	—	1	3	—	24
14. a.	*Caranx*	64	87	106	81	108	125	134	133	134	147	196
b.	*Chorinemus*	—	—	—	—	—	—	—	—	—	—	—
c.	*Trachynotus*	—	—	—	—	—	—	—	—	—	—	—
d.	Other carangids	—	—	—	—	—	—	—	—	—	—	—
e.	*Coryphaena*	—	—	—	—	—	—	—	—	—	—	—
f.	*Elacate*	—	—	—	—	—	—	—	—	—	—	—
15. a.	*Leiognathus*	41	54	50	47	80	117	97	89	78	102	275
b.	*Gazza*	—	—	—	—	—	—	—	—	—	—	
16.	*Lactarius*	—	—	—	—	—	—	—	—	—	—	—
17.	Pomfrets	10	7	6	11	14	30	30	25	29	15	6
18.	Mackerel	22	47	100	38	115	77	111	106	92	183	156
19.	Seer fish	46	75	91	63	85	93	119	127	138	117	149
20.	Tunnies	12	9	13	7	9	13	37	57	57	55	42
21.	*Sphyraena*	18	18	13	26	25	49	76	80	95	67	40
22.	*Mugil*	52	69	80	74	84	101	130	131	121	117	78
23.	*Bregmaceros*	—	—	—	—	—	—	—	—	—	—	—
24.	Soles	—	—	—	—	—	—	—	—	—	—	—
25. a.	Penaeid prawns	12	12	8	28	28	39	45	38	64	54	26
b.	Non penaeid prawns	—	—	—	—	—	—	—	—	—	—	1
c.	Lobsters	—	—	—	—	—	—	—	—	—	—	14
d.	Other crustaceans	—	—	—	—	—	—	—	—	—	—	—
26.	Cephalopods	—	—	—	—	—	—	—	—	—	—	—
27.	Miscellaneous	50	104	84	230	118	149	119	97	69	94	87
	TOTAL	569	780	854	920	1,104	1,334	1,532	1,579	1,721	1,803	1,862

composition of total marine fish catch in Lakshadweep during 1971 to 1981.

Species composition

Some changes have been effected in the specieswise presentation of catch data from 1981 onwards (Table 2). The estimates of marine fish catch were classified under 27 groups till 1980. This year the revision of these groups was done with a view to bring in the related genera/species of fishes under the relevant headings. For example *Chirocentrus* (wolf herring) has been brought under the broad category of clupeoids under which also fall oil sardine, lesser sardines, hilsa shad, other shads, anchovies and others. Under some groups, further categorisation was done on the basis of their commercial importance. For instance, the pomfrets have been categorised into black, silver and chinese pomfrets. Because of their potential importance billfishes, hitherto falling under miscellaneous, have been grouped separately. *Trachynotus, Coryphaena* and *Elacate* have been brought under other carangids and similarly *Gazza* has been brought under silverbellies. Popular names have been given for all broad groupings and wherever changes in the names of fishes have been effected, the corresponding names hitherto followed are shown in brackets.

Major groups of fishes

From Table 2 it is noticed that oil sardine accounted for 2,21,026 t forming about 16% of the total all India catch during 1981. The other major groups of species in the order of abundance in their catch are Bombay duck (1,37,790 t, 10.0%), penaeid prawns (83,539 t, 6.1%), sciaenids (82,686 t, 6.0%), silverbellies (69,449 t,

Table 17. *Composition of marine fish landings in Lakshadweep during 1971 to 1981 (in tonnes)*

Sl.No.		Name of fish	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
1.		Elasmobranchs	120	157	171	253	325	354	296	198	364	284	211
2.		Eels	—	—	—	—	—	—	—	—	—	—	—
3.		Catfishes	—	—	—	—	1	—	—	—	—	—	—
4.		*Chirocentrus*	—	—	—	—	—	—	—	—	—	—	—
5.	a.	Oil sardine	—	—	—	—	—	—	—	—	—	—	—
	b.	Lesser sardines	—	—	—	—	—	—	—	—	—	—	—
	c.	*Hilsa ilisha*	—	—	—	—	—	—	—	—	—	—	—
	d.	Other *Hilsa*	—	—	—	—	—	—	—	—	—	—	—
	e.	*Anchoviella*	—	—	—	—	—	—	—	—	—	—	—
	f.	*Thrissocles*	—	—	—	—	—	—	—	—	—	—	—
	g.	Other clupeoids	—	—	—	—	—	—	—	—	—	—	—
6.	a.	*Harpodon nehereus*	—	—	—	—	—	—	—	—	—	—	—
	b.	*Saurida & Saurus*	—	—	—	—	—	—	—	—	—	—	—
7.		*Hemirhamphus & Belone*	9	19	99	27	29	33	58	144	101	99	113
8.		Flying fish	14	17	42	43	30	41	30	33	16	29	16
9.		Perches	43	83	130	159	186	193	211	163	203	376	315
10.		Red mullets	8	12	36	32	34	58	29	27	27	27	25
11.		Polynemids	—	—	—	—	—	—	—	—	—	—	—
12.		Sciaenids	—	—	—	—	2	—	—	—	—	—	—
13.		Ribbon fish	—	—	—	—	—	—	—	—	—	—	—
14.	a.	*Caranx*	20	30	63	61	61	94	65	60	58	80	105
	b.	*Chorinemus*	—	—	—	—	—	—	—	—	—	—	—
	c.	*Trachynotus*	—	—	—	—	—	—	—	—	—	—	—
	d.	Other carangids	—	—	—	—	—	—	—	—	—	—	—
	e.	*Coryphaena*	—	—	—	—	—	—	—	—	—	—	—
	f.	*Elacate*	—	—	—	—	—	—	—	—	—	—	—
15.	a.	*Leiognathus*	—	—	—	—	5	—	—	—	—	—	—
	b.	*Gazza*	—	—	—	—	—	—	—	—	—	—	—
16.		*Lactarius*	—	—	—	—	—	—	—	—	—	—	—
17.		Pomfrets	—	—	—	—	—	—	—	—	—	—	—
18.		Mackerel	—	—	—	—	—	—	—	—	—	—	—
19.		Seer fish	48	51	29	91	66	87	41	41	24	21	50
20.		Tunnies	774	514	1,020	1,254	1,932	1,291	1,166	1,875	2,794	1,760	2,236
21.		*Sphyraena*	7	8	11	18	17	20	15	18	11	14	12
22.		*Mugil*	—	—	—	—	—	—	—	—	—	—	—
23.		*Bregmaceros*	—	—	—	—	—	—	—	—	—	—	—
24.		Soles	—	—	—	—	—	—	—	—	—	—	—
25.	a.	Penaeid prawns	—	—	—	—	—	—	—	—	—	—	—
	b.	Non penaeid prawns	—	—	—	—	—	—	—	—	—	—	—
	c.	Lobsters	—	—	—	—	—	—	—	—	—	—	—
	d.	Other crustaceans	—	—	—	—	—	—	—	—	—	—	—
26.		Cephalopods	13	17	20	15	19	40	23	20	15	13	14
27.		Miscellaneous	134	172	232	279	224	361	281	201	233	206	203
		TOTAL	1,190	1,080	1,853	2,232	2,931	2,572	2,315	2,780	3,846	2,909	3,300

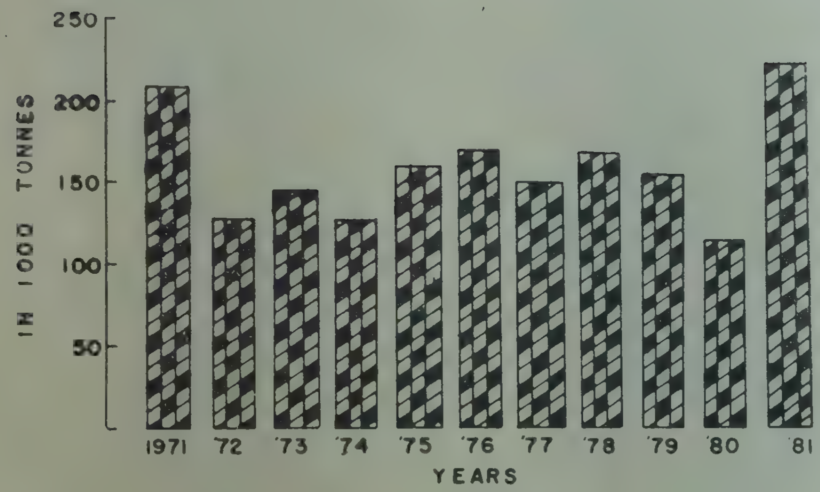

Fig. 2. Landings of oil sardine during 1971 to 1981.

5.0%), lesser sardines (61,980 t, 4.5%), non-penaeid prawns (61,430 t, 4.5%), cat fishes (59,390 t, 4.3%), elasmobranchs (56,008 t, 4.1%), pomfrets (48,728 t, 3.5%) and mackerel (48,660 t, 3.5%).

Oil sardine

During 1981, the oil sardine landings showed an increase of about 1,05,000 t (91%) as compared to 1980. Both Kerala and Karnataka landed substantial quantities contributing to the total all India oil sardine catch, their individual share being 66% and 30% respectively. The oil sardine landings during 1971 to 1981 showed wide fluctuations (Table 4 and Fig. 2). The maximum and minimum landings were recorded in 1981 and 1980 respectively.

Bombay duck

The Bombay duck catch during 1981 increased by about 42,000 t (44%). Higher landings in the states of Maharashtra and Gujarat accounted for the significant increase in the total catch of Bombay duck in India. While Maharashtra showed 59%, Gujarat recorded 39% of the country's total catch in Bombay duck. Wide fluctuations in the total catch of Bombay duck were seen during 1971 to 1981 (Table 4 and Fig. 3). The highest and the lowest catch were recorded in 1981 and 1972 respectively.

Penaeid prawns

A decline to the extent of about 28,000 t (25%) was noticed in the total catch of penaeid prawns during 1981 as compared to 1980. This decline was mainly brought about by a sharp fall in Kerala, particularly in Sakthikulangara area where the fall in the catch was to the extent of about 27,000 t. In Gujarat and Maharashtra also there was a decline to the tune of about 3,500 and 1,700 t respectively in 1981 as compared to 1980. However, in Tamil Nadu, Andhra Pradesh and Karnataka the landings increased by about 4,500, 1,100 and 1,100 t respectively. Table 4 and Fig. 4 show year to year fluctuations of penaeid prawn landings in India from 1971 to 1981. While the maximum catch was recorded in 1975, the minimum was seen in 1971, the respective figures being 1.42 lakhs and 0.72 lakh t.

Sciaenids

The landings of sciaenids during 1981 showed a decline of about 6,700 t (7%) as compared to 1980. The states of Tamil Nadu, Kerala and Andhra Pradesh, recorded lesser landings to the extent of about 6,400,

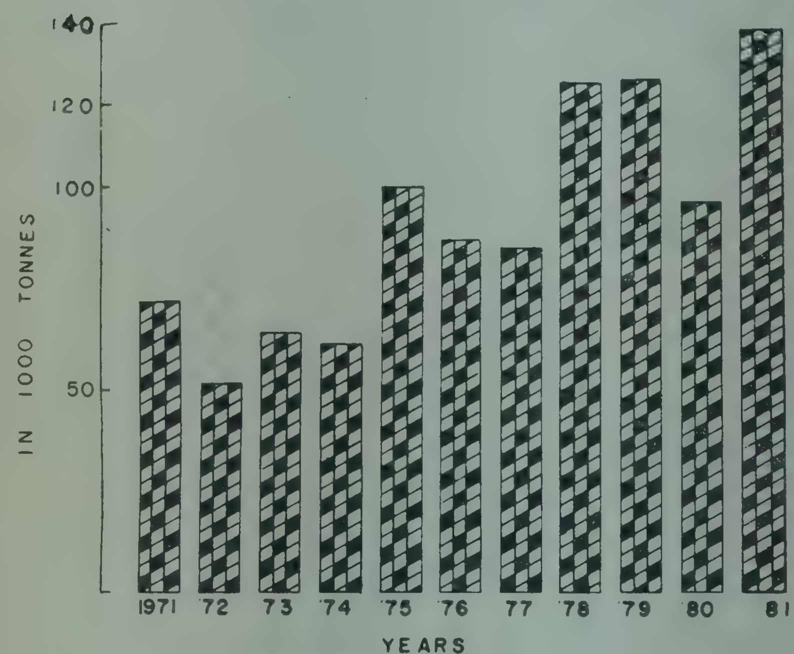

Fig. 3. Landings of Bombay duck *(Harpodon nehereus)* during 1971 to 1981.

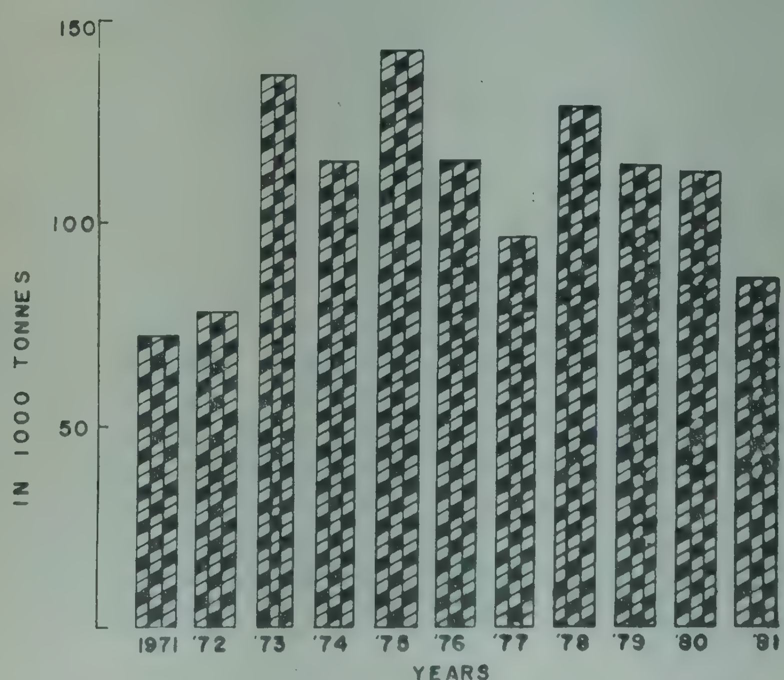

Fig. 4. Landings of penaeid prawns during 1971 to 1981.

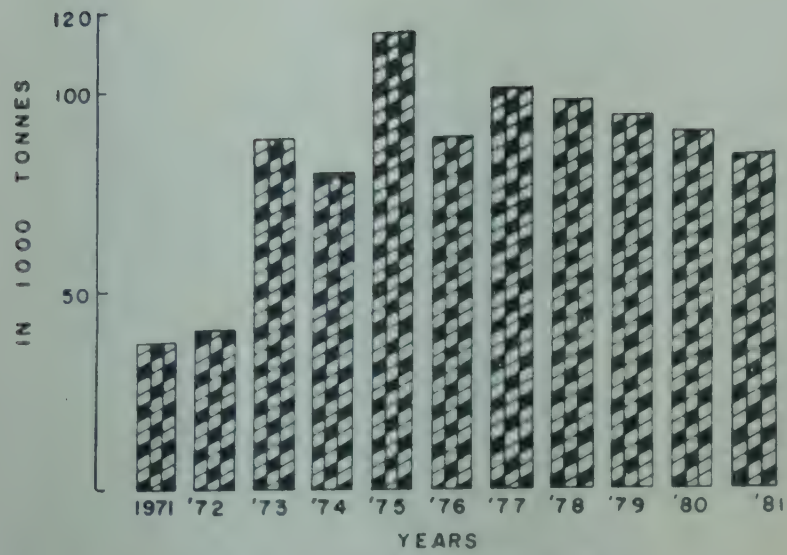

Fig. 5. Landings of sciaenids during 1971 to 1981

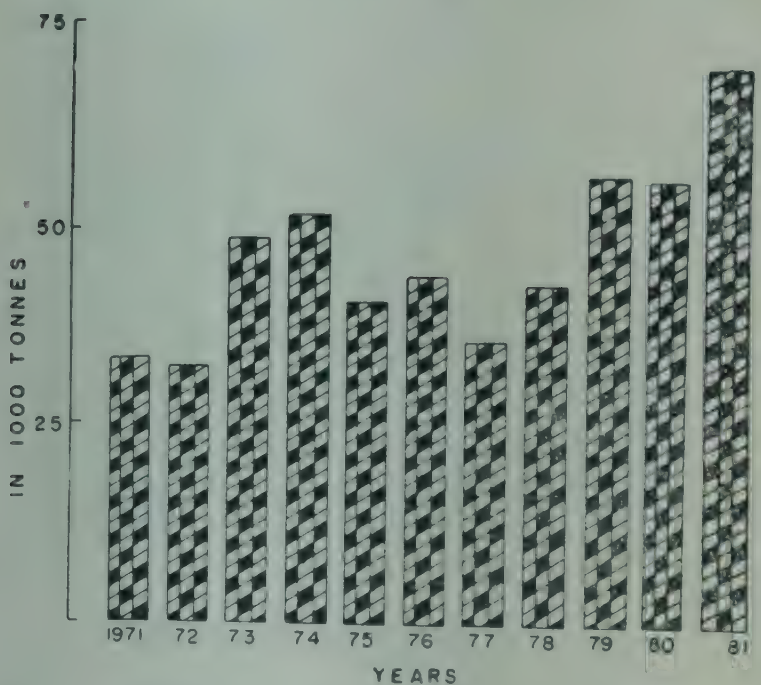

Fig. 6. Landings of silverbellies during 1971 to 1981

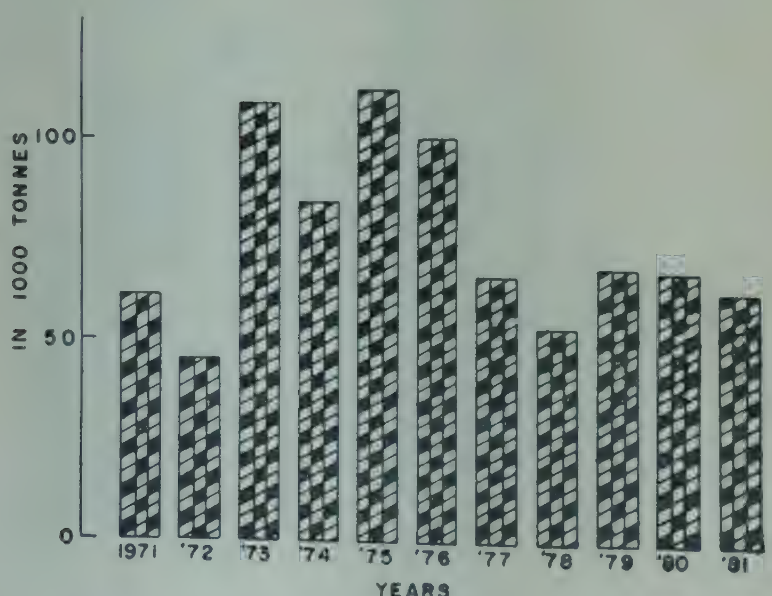

Fig. 7. Landings of lesser sardines during 1971 to 1981

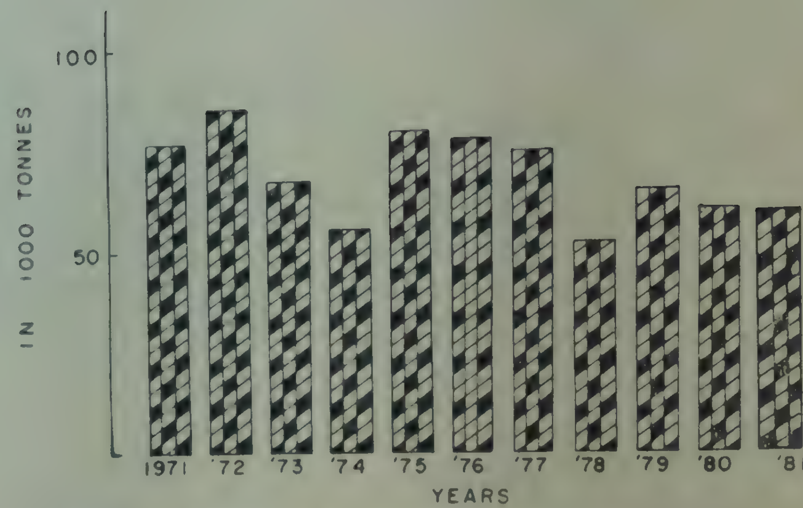

Fig. 8. Landings of non-penaeid prawns during 1971 to 1981

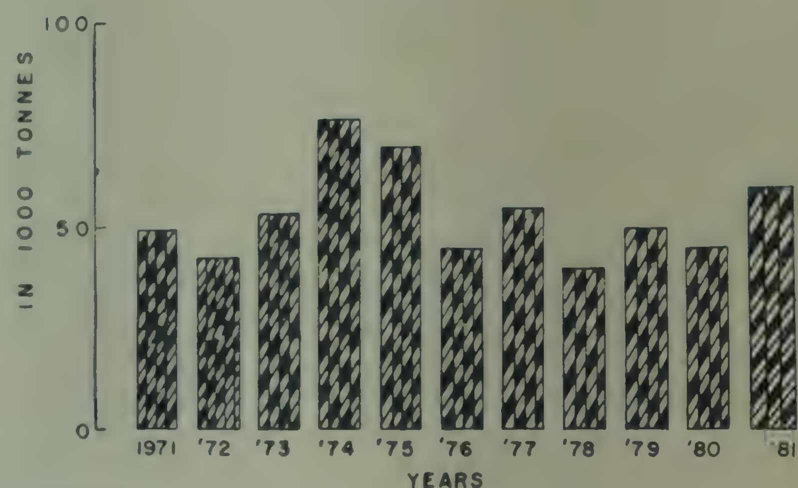

Fig. 9. Landings of catfishes during 1971 to 1981

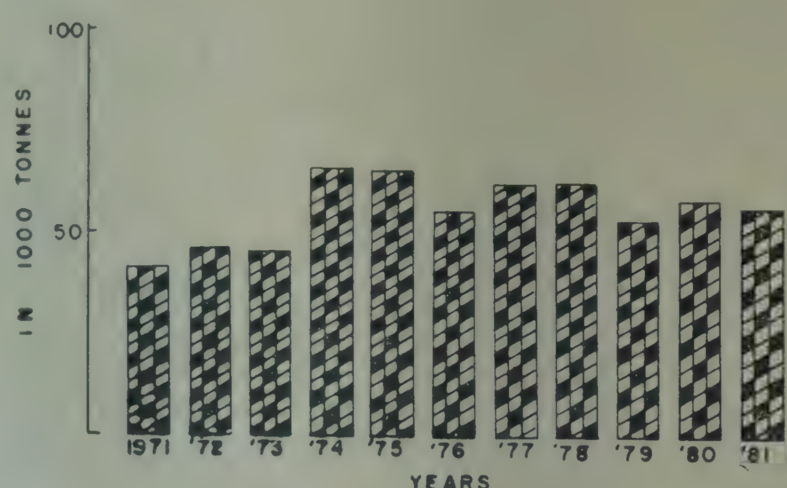

Fig. 10. Landings of elasmobranchs during 1971 to 1981

3,000 and 2,500 t respectively. The landings in Gujarat and Maharashtra, however, increased by about 3,600 and 3,500 t respectively. The sciaenids landings during 1971 to 1981 showed wide fluctuations (Fig. 5 and Table 4). The maximum and minimum landings were recorded in 1975 and 1971 respectively.

Silverbellies

An increase of about 15,000 t (27%) in the total catch of siverbellies was seen during 1981 as compared to 1980. This was mainly due to higher landings in the states of Tamil Nadu and Andhra Pradesh, the increase being about 13,000 and 6,000 t respectively. However, Karnataka and Kerala recorded lower landings to the extent of about 3,000 and 1,300 t respectively. Table 4 and Fig. 6 show annual landings of silverbellies during the years 1971 to 1981 which show fluctuating trend. While the maximum landings were recorded in 1981, the minimum catch was in 1972.

Lesser sardines

The total catch of lesser sardines declined by about 5,100 t (8%). Reduced landings in the states of Tamil Nadu, Kerala and Pondicherry by about 5,500, 3,400 and 1,400 t respectively brought down the total all India catch. Andhra Pradesh and Karnataka, however, recorded higher landings by about 1,800 and 1,200 t respectively. The landings of lesser sardines during the year 1971 to 1981 are presented in Table 4 and Fig. 7. The maximum and minimum landings were recorded in 1975 and 1972 respectively, the corresponding figures being 1,12,117 and 44,629 t.

Non-penaeid prawns

The landings of non-penaeid prawns during 1981 showed a marginal increase of about 2,700 t (5%). While Maharashtra and Gujarat recorded higher landings by about 5,500 and 600 t respectively, the landings in Andhra Pradesh and Kerala declined by about 2,700 and 1,500 t respectively. Table 4 and Fig. 8 give the trend in the yield of non-penaeid prawns during 1971 to 1981. While the maximum catch of 85,488 t was recorded in 1972 the minimum was recorded in 1978 (50,652 t.)

Catfishes

A substantial increase to the extent of about 15,600 t (36%) in the total catch of catfishes was noticed during 1981 as compared to 1980. This was possible by comparatively higher landings of catfishes in the states of Gujarat, Maharashtra, Karnataka and Andhra Pradesh to the extent of about 5,100, 2,400, 2,100 and 1,900 t respectively. Kerala, however recorded lower landings by about 4,400 t. The trend in the catch of catfishes for the years 1971 to 1981 are shown in Table 4 and Fig. 9. While the maximum catch was recorded in 1974 (76,196 t), the minimum was seen in 1978 (39,231 t).

Elasmobranchs

The landings of elasmobranchs during 1981 declined marginally by about 1,900 t (3%). While Tamil Nadu, Kerala and Gujarat accounted for the decline by about 2,200, 1,900 and 1,100 t respectively, the landings in Maharashtra and Karnataka increased by about 1,900 and 1,200 t respectively. Fig. 10 and Table 4 show the catch trends during the 11 year period 1971 to 1981. The maximum catch of 66,054 t was recorded in 1974 and the minimum was observed in 1971 (41,348 t).

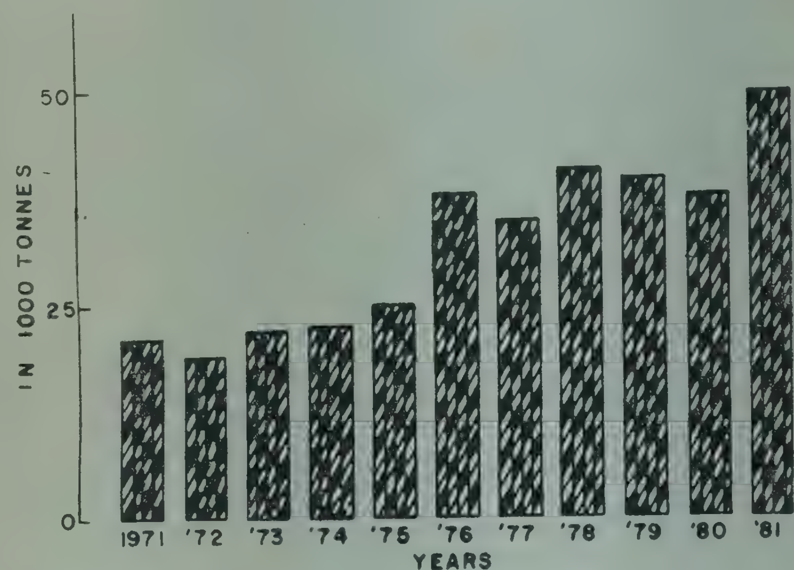

Fig. 11. Landings of pomfrets during 1971 to 1981.

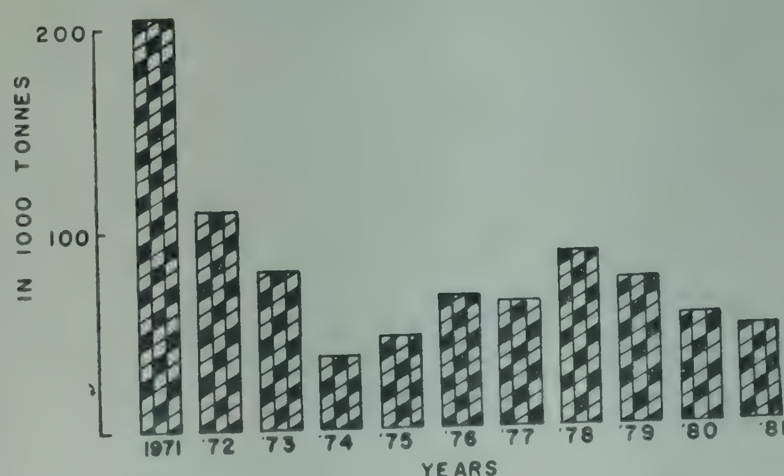

Fig. 12. Landings of mackerel during 1971 to 1981.

Pomfrets

A significant increase of about 10,500 t (27%) in the total catch of pomfrets was observed during 1981. This was due to higher landings in the states of Maharashtra and Gujarat to the extent of about 7,100 and 6,600 t respectively. The catch in Orissa, however, showed a decline of about 5,400 t. The trend in the landings of pomfrets for the years 1971 to 1981 are shown in Table 4 and Fig. 11. While the maximum catch was recorded in 1981 (48,728 t), the minimum was seen in 1972 (19,007 t).

Mackerel

The catch of mackerel during 1981 showed a decline of about 6,600 t (12%). While Tamil Nadu, Andhra Pradesh and Kerala recorded lower landings by about 3,300, 2,900 and 2,300 t respectively, Goa accounted for an increase of about 1,500 t. Fig. 12 and Table 4 show the trend in the landings of mackerel during the years 1971 to 1981. The maximum catch of 204,575 t was recorded in 1971 and the minimum was observed in 1974 (37,462 t).

Statewise mechanised and non-mechanised fishing in 1981

Table 18 shows the statewise total mechanised and non-mechanised landings and of important species viz. oil sardine, mackerel, Bombay duck, sciaenids, perches, pomfrets, tunnies, penaeid and non-penaeid prawns and others during 1981. The salient features in different states are summarised below.

Table 18. *Statewise landings of marine fish from mechanised and non-mechanised fishing crafts during* 1981 *(in tonnes)*

STATE	WEST BENGAL			ORISSA					ANDHRA PRAD		
Name of fish	Mechanised	Non mechanised	Grand total	Mechanised Trawlers	Mechanised Others	Total	Non mechanised	Grand total	Mechanised Trawlers	Mechanised Others	T
Oil sardine	—	—	—	—	—	—	—	—	—	—	
Mackerel	—	—	—	—	—	—	823	823	45	3	
Bombay duck	8	610	618	12	—	12	61	73	44	—	
Sciaenids	47	223	270	1,629	48	1,677	456	2,133	2,851	2	2,
Perches	8	29	37	62	—	62	60	122	3,846	5	3,
Pomfrets	2,705	613	3,318	174	2,308	2,482	1,203	3,685	171	—	
Tunnies	—	—	—	9	—	9	241	250	7	—	
Penaeid prawns	—	244	244	1,188	—	1,188	140	1,328	4,658	144	4.
Non-penaeid prawns	—	1,251	1,251	53	—	53	2	55	387	—	
Others	10,330	4,039	14,369	2,895	10.798	13,693	13,493	27,186	14,164	180	14,
TOTAL	13,098	7,009	20,107	6,022	13,154	19,176	16,479	35,655	26,173	334	26.
No. of operations of units	35,385	65,392		55,235	1,66,402		7,07,518		1,11,947	—	

STATE	PONDICHERRY					KARNATAKA					
Name of fish	Mechanised Trawlers	Mechanised Others	Total	Non mechanised	Grand total	Mechanised Trawlers	Mechanised Purse-seiners	Mechanised Others	Total	Non mechanised	Gra total
Oil sardine	—	—	—	—	—	3,703	56,572	631	60,906	4,708	65
Mackerel	—	—	—	316	316	15	15,432	100	15,547	4,219	19
Bombay duck	—	—	—	—	—	—	—	—	—	—	
Sciaenids	149	—	149	181	330	848	140	2	990	1,305	2
Perches	724	—	724	208	932	134	—	8	142	256	
Pomfrets	8	—	8	115	123	29	6	17	52	367	
Tunnies	1	34	35	20	55	—	2,299	89	2,388	129	2
Penaeid prawns	290	—	290	46	336	3,231	133	—	3,364	758	4
Non-penaeid prawns	10	—	10	43	53	4	—	—	4	—	
Others	2,345	220	2,565	6,045	8,610	24,506	20,892	727	46,125	12,089	58
TOTAL	3,527	254	3,781	6,974	10,755	32,470	95,474	1,574	1,29,518	23,831	1,53
No. of operations of units	33,766	1,120		2,23,897		1,18,297	31,123	4,616		2,40,191	

West Bengal

In West Bengal, the mechanised catch during 1981 formed about 65% of the total catch. The catch of pomfrets from mechanised crafts was 21%. From non-mechanised crafts, the catch of prawns, Bombay duck and pomfrets was 21, 9 and 9 per cent respectively of the total catch.

Orissa

Fifty four per cent of the total catch in Orissa during 1981 came from mechanised crafts. The landings of pomfrets, sciaenids and prawns from mechanised crafts were 13, 9 and 6 per cent respectively. In non-mechanised fishing crafts, the catch of pomfrets formed about 7% and mackerel and sciaenids contributed to about 5% and 3% respectively of the total catch.

Andhra Pradesh

In Andhra Pradesh, 23% of the total catch came from mechanised fishing crafts, the balance being from non-mechanised crafts. The catch of prawns in mechanised fishing crafts was 20%, the share of perches and sciaenids being 15 and 11% of the total catch. Sciaenids contributed 5% of the total non-mechanised catch while prawns, mackerel, pomfrets and perches landed 5,4,3 and 2 per cent respectively.

Tamil Nadu

The share of mechanised catch in the total catch in Tamil Nadu during the year was 48%. Trawlers landed about 98% of the total mechanised catch. Prawns, sciaenids and perches contributed 11%, 10% and 3%

		TAMIL NADU					KERALA					
Non mechanised	Grand total	Mechanised Trawlers	Mechanised Others	Total	Non mechanised	Grand total	Mechanised Trawlers	Mechanised Purse-seiners	Mechanised Others	Total	Non mechanised	Grand total
—	—	—	—	—	195	195	476	12,334	22,738	35,548	1,11,438	1,46,986
3,207	3,255	31	5	36	3,880	3,916	19	3,932	100	4,051	12,148	16,199
801	845	—	—	—	3	3	—	—	—	—	—	—
4,193	7,046	10,273	—	10,273	2,867	13,140	2,305	3	170	2,478	667	3,145
1,837	5,688	2,936	151	3,087	3,366	6,453	6,473	3	175	6,651	1,898	8,549
2,527	2,698	73	7	80	590	670	8	22	375	405	968	1,373
331	338	—	564	564	3,256	3,820	—	222	1,424	1,646	3,863	5,509
1,926	6,728	11,612	6	11,618	1,930	13,548	16,305	1	3	16,309	5,959	22,268
1,220	1,607	72	—	72	632	704	—	—	—	—	160	160
73,594	87,938	79,448	1,486	80,934	97,913	1,78,847	23,727	1,156	4,350	29,233	40,973	70,206
89,636	1,16,143	1,04,445	2,219	1,06,664	1,14,632	2,21,296	49,313	17,673	29,335	96,321	1,78,074	2,74,395
,56,085		4,43,818	11,294		34,50,818		2,68,045	6,760	70,733		18,66,475	

GOA					MAHARASHTRA					GUJARAT				
Mechanised Trawlers	Mechanised Others	Total	Non mechanised	Grand total	Mechanised Trawlers	Mechanised Others	Total	Non mechanised	Grand total	Mechanised Trawlers	Mechanised Others	Total	Non mechanised	Grand total
14	6,663	6,677	932	7,609	95	332	427	195	622	—	—	—	—	—
9	3,558	3,567	372	3,939	4	42	46	243	289	—	—	—	—	—
—	—	—	1	1	280	79,349	79,629	2,507	82,136	2,532	16,448	18,980	35,134	54,114
,417	1	1,418	192	1,610	10,012	4,372	14,384	3,091	17,475	26,685	5,710	32,395	2,847	35,242
750	225	975	208	1,183	2,201	266	2,467	150	2,617	3,491	620	4,111	721	4,832
44	40	84	39	123	246	14,579	14,825	2,319	17,144	2,613	13,935	16,548	2,621	19,169
46	42	88	100	188	457	719	1,176	72	1,248	126	1,380	1,506	94	1,600
,025	7	2,032	205	2,237	13,737	5,569	19,306	2,411	21,717	7,949	419	8,368	2,617	10,985
—	—	—	—	—	1,171	46,257	47,428	5,426	52,854	856	1,698	2,554	2,188	4,742
,771	4,901	14,672	2,936	17,608	22,563	39,009	61,572	14,913	76,485	54,547	34,441	88,988	14,838	1,03,826
,076	15,437	29,513	4,985	34,498	50,766	1,90,494	2,41,260	31,327	2,72,587	98,799	74,651	1,73,450	61,060	2,34,510
,188	19,292	80,480	97,215		72,746	2,59,471		3,03,749		1,21,497	2,61,970		5,65,576	

Table 19. *Composition of marine fish landings from mechanised boats at major fish landings centres along the east coast of India (in tonnes)*

Sl.No.	Name of fish	Visakhapatnam outer harbour Trawl net 1981	1980	Kakinada fisheries harbour Trawl net 1981	1980	Pudumanikuppam Trawl net 1981	Gill net 1981	Total 1981	1980	Cuddalore fisheries harbour Trawl net 1981	Gill net 1981	Total 1981	1980
1.	Elasmobranchs		187		188				145				26
a.	Sharks	22	—	56	—	87	95	182	—	—	44	44	—
b.	Skates	42	—	47	—	11	1	12	—	—	—	—	—
c.	Rays	78	—	304	—	214	71	285	—	9	—	9	—
2.	Eels	16	12	141	133	9	—	9	—	—	—	—	—
3.	Catfishes	150	197	190	131	15	6	21	2	1	—	1	4
4.	Clupeoids	—	—	—	—	—	—	—	—	—	—	—	—
a.	Wolf herring *(Chirocentrus)*	5	1	—	—	1	—	1	—	—	—	—	—
b.	Oil sardine	—	—	—	—	—	—	—	—	—	—	—	—
c.	Other sardines (Lesser sardines)	35	1	2	22	2	—	2	—	—	—	—	—
d.	Hilsa shad *(Hilsa ilisha)*	—	—	—	—	—	—	—	—	—	—	—	—
e.	Other shads (Other *Hilsa*)	—	—	—	—	—	—	—	—	—	—	—	—
f.	Anchovies									1	—	1	—
	Coilia	—	—	—	—	—	—	—	—	—	—	—	—
	Setipinna	—	—	—	—	—	—	—	—	—	—	—	—
	Stolephorus (Anchoviella)	133	116	187	540	166	—	166	21	15	—	15	137
	Thrissina	—	—	—	—	—	—	—	—	—	—	—	—
	Thryssa (Thrissocles)	68	101	81	217	59	—	59	—	1	—	1	13
g.	Other clupeoids	28	—	106	167	—	—	—	—	24	—	24	23
5.	Bombay duck *(Harpodon nehereus)*	—	6	34	70	—	—	—	—	—	—	—	—
6.	Lizard fishes *(Saurida & Saurus)*	501	622	219	130	464	—	464	108	117	—	117	199
7.	Half beaks & full beaks *(Hemirhamphus & Belone)*	—	—	—	19	—	—	—	—	—	—	—	—
8.	Flying fishes	—	—	—	—	—	—	—	—	—	—	—	—
9.	Perches	—	1,736	—	447	—	—	—	208	—	—	—	292
a.	Rock cods	3	—	—	—	—	—	—	—	—	—	—	—
b.	Snappers	—	—	2	—	—	—	—	—	—	—	—	—
c.	Pig-face breams	—	—	—	—	—	—	—	—	—	—	—	—
d.	Threadfin breams	361	—	417	—	795	—	795	—	98	—	98	—
e.	Other perches	656	—	378	—	357	—	357	—	28	—	28	—
10.	Goatfishes (Red mullets)	102	86	28	79	6	—	6	6	27	—	27	97
11.	Threadfins (Polynemids)	39	22	10	16	2	—	2	6	—	—	—	—
12.	Croakers (Sciaenids)	601	898	507	911	507	—	507	143	73	—	73	83
13.	Ribbon fishes	853	492	318	885	186	—	186	107	2	—	2	57
14.	Carangids	—	858	—	390	—	—	—	—	—	—	—	—
a.	Horse mackerel	—	—	—	—	—	—	—	8	—	—	—	6
b.	Scads	333	—	1,203	—	10	—	10	—	—	—	—	—
c.	Leather-jackets *(Chorinemus)*	—	—	—	—	2	5	7	—	—	4	4	—
d.	Other carangids	83	—	71	90	39	10	49	—	16	—	16	—

Table 19 Contd.

15.	Silver bellies *(Leiognathus & Gazza)*	380	503	393	588	1,577	—	1,577	162	334	—	334	643
16.	Big-jawed jumper *(Lactarius)*	54	23	15	60	—	—	—	—	—	—	—	4
17.	Pomfrets	—	5	—	15	—	—	—	—	—	—	—	2
a.	Black pomfret	7	—	—	—	2	1	3	—	—	—	—	—
b.	Silver pomfret	13	—	11	—	2	—	2	—	—	—	—	—
c.	Chinese pomfret	—	—	—	—	—	—	—	—	1	—	1	—
18.	Mackerel	—	76	—	161	—	—	—	—	—	—	—	—
a.	Indian mackerel	8	—	1	—	9	—	9	—	—	—	—	—
b.	Other mackerels	—	—	—	—	—	—	—	—	—	—	—	—
19.	Seer fishes								25				
a.	*S. commersoni*	—	—	—	—	12	69	81	—	—	23	23	1
b.	*S. guttatus*	1	—	—	—	4	31	35	—	—	—	—	—
c.	*S. lineolatus*	—	—	—	—	—	9	9	—	—	—	—	—
d.	*Acanthocybium* Sp.	—	—	—	—	—	—	—	—	—	—	—	—
20.	Tunnies								4				1
a.	*E. affinis*	—	—	—	—	—	10	10	—	—	23	23	—
b.	*Auxis spp.*	—	—	—	—	—	—	—	—	—	—	—	—
c.	*K. pelamis*	—	—	—	—	—	8	8	—	—	—	—	—
d.	*T. tonggol*	—	—	—	—	—	—	—	—	—	—	—	—
e.	Other tunnies	—	—	—	—	—	3	3	—	—	—	—	—
21.	Bill fishes						19	19		—	6	6	—
22.	Barracudas *(Sphyraena)*	14	2	21	11	11	—	11	6	—	4	4	1
23.	Mullets *(Mugil)*	—	—	—	—	—	—	—	—	—	—	—	—
24.	Unicorn cod *(Bregmaceros)*	—	—	—	—	—	—	—	—	—	—	—	—
25.	Flatfishes	—	—	—	—	—	—	—	—	—	—	—	—
a.	Halibut *(Psettodes erumei)*	5	—	—	—	—	—	—	—	—	—	—	—
b.	Flounders	—	—	—	—	—	—	—	—	—	—	—	—
c.	Soles	74	135	94	161	46	—	46	4	14	—	14	13
26.	Crustaceans												
a.	Penaeid prawns	816	784	1,953	1,865	1,023	—	1,023	165	104	—	104	121
b.	Non penaeid prawns	1	—	366	833	174	—	174	—	—	—	—	—
c.	Lobsters	1	—	—	—	—	—	—	—	—	—	—	—
d.	Crabs	361	400	254	352	—	—	—	51	31	—	31	25
e.	Stomatopods	12	—	254	—	—	—	—	11	2	—	2	6
27.	Cephalopods	206	246	88	126	128		128	44	28	—	28	40
28.	Miscellaneous	44	542	165	418	281	1	282	270	78	—	78	175
	TOTAL	6,106	8,051	7,916	9,025	6,201	339	6,540	1,496	1,004	104	1,108	1,969
	No. of operations of fishing units	31,689	35,406	35,715	40,674	26,671	2,127		14,129	8,043	863		16,012

Table 19. *Composition of marine fish landings from mechanised boats at major fish landing centre along the east coast of India (in tonnes)* *(Continued)*

Sl.No.		Name of fish	Nagapatnam Trawl net 1981	Nagapatnam Trawl net 1980	Mandapam Trawl net 1981	Mandapam Trawl net 1980	Rameswaram Trawl net 1981	Rameswaram Gill net 1981	Rameswaram Total 1981	Rameswaram 1980	Tuticorin fisheries harbour Trawl net 1981	Tuticorin fisheries harbour Gill net 1981	Tuticorin fisheries harbour Total 1981	Tuticorin fisheries harbour 1980
1.		Elasmobranchs	—	78		142	—	—	—	2,370	—	—	—	751
	a.	Sharks	25	—	1	—	—	2	2	—	278	2	280	—
	b.	Skates	—	—	—	—	—	—	—	—	—	—	—	—
	c.	Rays	138	—	289	—	3,453	—	3,453	—	325	2	327	—
2.		Eels	12	5	4	—	—	—	—	—	2	—	2	—
3.		Cat fishes	51	4	153	81	79	2	81	179	393	1	394	5
4.		Clupeoids												
	a.	Wolf herring *(Chirocentrus)*	15	—	3	—	—	4	4	—	92	3	95	7
	b.	Oil sardine	—	—	—	—	—	—	—	—	—	—	—	—
	c.	Other sardines (Lesser sardines)	2	2	47	36	11	—	11	23	50	1	51	—
	d.	Hilsa shad *(Hilsa ilisha)*	—	—	12	—	—	—	—	—	—	—	—	
	e.	Other shads (Other *Hilsa)*	—	—	16	11	95	—	95	77	—	—	—	8
	f.	Anchovies												
		Coilia	171	—	—	—	—	—	—	—	—	—	—	—
		Setipinna	—	—	—	—	—	—	—	—	—	—	—	—
		Stolephorus (Anchoviella)	183	253	—	—	—	—	—	—	226	—	226	90
		Thrissina	—	—	—	—	—	—	—	—	—	—	—	—
		Thryssa (Thrissocles)	114	17	36	6	1	—	1	11	1,120	—	1,120	20
	g.	Other clupeoids	247	241	62	4	9	—	9	11	432	3	435	34
5.		Bombay duck *(Harpodon nehereus)*	—	—	—	—	—	—	—		—	—	—	—
6.		Lizard fishes *(Saurida & Saurus)*	146	91	10	5	205		205	135	18	—	18	37
7.		Half beaks & full beaks				1	—	—						
		(Hemirhamphus & Belone)	—	—	—	—	—	—	—	—	—	—	—	—
8.		Flying fishes												
9.		Perches		142		1				13				19
	a.	Rock cods	—	—	9	—	—	—	—	—	4	3	7	—
	b.	Snappers	—	—		—	—	—	—	—	7	—	7	—
	c.	Pig-face breams	—	—	2	—	—	—	—	—	4	—	4	—
	d.	Threadfin breams	248	—	2	—	—	—	—	—	15	—	15	—
	e.	Other perches	112	—	70	—	55	—	55	—	9	1	10	—
10.		Goatfishes (Red mullets)	10	19	52	32	508	—	508	340	—	—	—	—
11.		Threadfins (Polynemids)	—	—	1	—	—	—	—	—	—	—	—	—
12.		Croakers (Sciaenids)	500	199	280	64	2,126	—	2,126	816	704	—	704	1,010
13.		Ribbon fishes	75	26	11	—	—	—	—	—	87	—	87	32
14.		Carangids												
	a.	Horse mackerel	—	65	—	1	—	—	—	15	—	—	—	—
	b.	Scads	—	—	—	—	—	—	—	—	—	—	—	—
	c.	Leather-jackets ((*Chorinemus)*	—	—	6	—	—	—	—	—	—	—	—	—
	d.	Other carangids	142	—	29	—	17	—	17	—	3	1	4	—

Table 19 Contd.

15.		Silver bellies *(Leiognathus & Gazza)*	756	449	3,194	1,592	10,310	—	10,310	7,474	1,714	—	1,714	543
16.		Big-jawed jumper *(Lactarius)*	49	39	2	1	—	—	—	—	11	4	15	—
17.		Pomfrets		7		2	—	—	—	—	—	—	—	—
	a.	Black pomfret	5	—	1	—	—	—	—	—	—	—	—	—
	b.	Silver pomfret	28	—	3	—	—	—	—	—	2	—	2	—
	c.	Chinese pomfret	—	—	—	—	—	—	—	—	—	—	—	—
18.		Mackerel	—	1	—	1	—	—	—	2	—	—	—	—
	a.	Indian mackerel	—	—	—	—	4	—	4	—	—	5	5	—
	b.	Other mackerels	—	—	—	—	—	—	—	—	—	—	—	—
19.		Seer Fishes	—	—	—	—	—	—	—	—	—	—	—	14
	a.	*S. commersoni*	—	—	—	—	—	—	—	—	1	7	8	—
	b.	*S. guttatus*	—	—	—	—	—	—	—	—	—	—	—	—
	c.	*S. lineolatus*	—	—	—	—	—	—	—	—	—	—	—	—
	d.	*Acanthocybium* Sp.	—	—	—	—	—	—	—	—	—	—	—	—
20.		Tunnies												
	a.	*E. affinis*	—	—	—	—	—	—	—	—	—	—	—	—
	b.	*Auxis spp.*	—	—	—	—	—	—	—	—	—	—	—	—
	c.	*K. pelamis*	—	—	—	—	—	—	—	—	—	—	—	—
	d.	*T. tonggol*	—	—	—	—	—	—	—	—	—	—	—	—
	e.	Other tunnies	—	—	—	—	—	—	—	—	—	—	—	—
21.		Bill fishes			—	—	—	—	—	—	—	—	—	—
22.		Barracudas *(Sphyraena)*	17	1	—	—	—	—	—	—	13	3	16	—
23.		Mullets *(Mugil)*	3	2	—	—	—	—	—	—	—	—	—	—
24.		Unicorn Cod *(Bregmaceros)*	—	—	—	—	—	—	—	—	—	—	—	—
25.		Flatfishes	—	—	—	—	—	—	—	—	—	—	—	—
	a.	Halibut *(Psettodes erumei)*	60	—	—	—	—	—	—	—	—	—	—	—
	b.	Flounders	—	—	—	—	—	—	—	—	—	—	—	—
	c.	Soles	92	66	65	34	169	—	169	136	89	—	89	278
26.		Crustaceans												
	a.	Penaeid prawns	349	112	803	217	2,101	—	2,101	1,367	3,431	—	3,431	626
	b.	Non penaeid prawns	24	13	—	—	—	—	—	—	—	—	—	—
	c.	Lobsters	3	—	—	—	—	—	—	—	—	—	—	—
	d.	Crabs	91	35	232	150	640	—	640	401	42	—	42	41
	e.	Stomatopods	—	—	13	1	50	—	50	201	—	—	—	—
27.		Cephalopods	22	13	31	33	158	—	158	90	23	—	23	—
28.		Miscellaneous	183	127	20	118	587	—	587	717	3,274	3	3,277	3,070
		TOTAL	3,873	2,007	5,459	2,533	20,578	8	20,586	14,378	12,369	39	12,408	6,585
		No. of operations of fishing units	15,827	9,307	47,840	25,143	101,449	79		78,758	31,846	235		30,711

respectively to the total mechanised catch. From non-mechanised fishing crafts the landings of mackerel, perches, tunnies, sciaenids and prawns were about 3,900, 3,400, 3,300, 2,900 and 2,600 t respectively.

Pondicherry

In Pondicherry, the mechanised catch during 1981 formed about 35% of the total catch, of which 93% came from trawlers.

Kerala

Mechanised boats in Kerala during the year landed about 35% of the total catch. Out of the total mechanised catch of about 96,300 t, trawlers, purse seiners and others landed about 51%, 18% and 31% respectively. In trawler landings, prawns formed about 33% of the total catch from the craft. Oil sardine and mackerel were the major fishes landed by the purseseines, their contributions being 70% and 22% respectively. From non-mechanised fishing crafts, the landings of oil sardine and mackerel formed about 63% and 7% respectively.

Karnataka

In Karnataka, 84% of the total catch came from mechanised fishing crafts. Out of a total of about 130,000 t of mechanised catch, the share of purse-seiners, trawlers and others was 74%, 25% and 1% respectively. The landings of oil sardine and mackerel from purse seines were 56,600 (59%) and 15,400 (16%) t respectively. From non-mechanised boats, the landings of oil sardine, mackerel and sciaenids formed about 20%, 18% and 5% respectively.

Goa

The landings from mechanised fishing crafts in Goa represented about 86%. Trawlers landed about 48% of the total mechanised catch. The landings of prawns, sciaenids and perches in trawlers were 2,000, 1,400 and 750 t respectively. Oil sardine and mackerel from non-mechanised fishing crafts formed about 19% and 7% respectively.

Maharashtra

In Maharashtra, the mechanised catch during 1981 formed about 89% of the total catch. The share of trawler catch in the total mechanised catch was about 21%. Prawns and sciaenids landings amounted to 14,908 (29%) and 10,000 t (20%) respectively from the trawlers. In non-mechanised fishing crafts, the landings of prawns, sciaenids, Bombay duck and pomfrets were 7,837 (25%), 3,091 (10%), 2,507 (8%) and 2,319 (7%) t respectively.

Gujarat

The landings from mechanised fishing crafts in Gujarat formed about 74% of the total catch in 1981. The trawler catch was about 57% of the total mechanised landings. Sciaenids and prawns landed about 27% and 9% respectively of the total catch from trawlers. In non-mechanised fishing crafts the share of Bombay duck was about 58% of the total catch.

Landings of mechanised boats at important landing centres

Vishakhapatnam Outer Harbour

The total landings from trawlers during 1981 showed a decline of about 1,900 t (24%) as compared to 1980 (Table 19). The number of operations also declined by about 3,700. The catch per unit effort during 1981 and 1980 was 193 and 227 kg respectively. The decline in the total landings was mainly due to lower landings of perches, carangids, croakers and silver bellies to the extent of about 720, 440, 300 and 120 t respectively. The landings of ribbon fish, however, showed an increase of about 360 t.

Kakinada Fisheries Harbour

Both the catch and the number of operations of trawlers declined during 1981 as compared to the previous year, the former by 1,109 t (12%) and the latter by 4,959 (12%) (Table 19). The catch per unit effort, however, remained more or less the same (222 kg) in 1981 and 1980. The lesser catch of clupeoids, ribbon fish, non-penaeid prawns, croakers, silverbellies and crabs by about 570, 570, 470, 400, 200 and 100 t respectively brought about the reduced total catch during 1981. However, an increase in the landings of carangids, perches, elasmobranchs and penaeid prawns by about 800, 350, 220 and 90 t respectively was noticed.

Padumanikuppam

The total landings from trawlers and gill netters during 1981 showed an increase of about 5,000 tonnes. (Table 19). In 1981, while 95% of the total mechanised catch was from trawlers, the balance came from gill netters. The catch per unit effort in respect of

Table 20. *Composition of marine fish landing from mechanised boats at major fish landing centres along the west coast of India (in tonnes).*

Sl.No.	Name of fish	SAKTHIKULANGARA 1981 Trawl net	SAKTHIKULANGARA 1981 Gill net	SAKTHIKULANGARA 1981 Total	SAKTHIKULANGARA 1980	COCHIN FISHERIES HARBOUR 1981 Trawl net	COCHIN FISHERIES HARBOUR 1981 Gill net	COCHIN FISHERIES HARBOUR 1981 Purse-seine	COCHIN FISHERIES HARBOUR 1981 Total	COCHIN FISHERIES HARBOUR 1980
1.	Elasmobranchs				1,722					523
a.	Sharks	7	402	409		7	465	1	473	
b.	Skates		23	23		1	9		10	
c.	Rays	325	15	340		47	36	5	88	
2.	Eels	2		2			1		1	5
3.	Catfishes	3,406	183	3,589	6,711	253	389	134	776	759
4.	Clupeoids									
a.	Wolf herring *(Chirocentrus)*		2	2			6		6	4
b.	Oil sardine	24		24	24	189	2	12,165	12,356	10,431
c.	Other sardines (Lesser sardines)							372	372	197
d.	Hilsa shad *(Hilsa ilisha)*									
e.	Other shads (Other *Hilsa)*									
f.	Anchovies									
	Coilia									
	Setipinna									
	Stolephorus *(Anchoviella)*	324		324	202	74		85	159	390
	Thrissina									
	Thryssa *(Thrissocles)*					23		13	36	92
g.	Other clupeoids					16		7	23	115
5.	Bombay duck *(Harpodon nehereus)*									
6.	Lizard fishes *(Saurida & Saurus)*	5,114	1	5,115	6,421	303			303	183
7.	Half beaks & full beaks *(Hemirhamphus & Belone)*		2	2	1		3	1	4	1
8.	Flying fishes									965
9.	Perches				14,926					
a.	Rock cods		13	13		5	2		7	
b.	Snappers					23	1	1	25	
c.	Pig-face breams									
d.	Threadfin breams	3,562		3,562		2,295			2,295	
e.	Other perches	209		209		178	8	2	188	
10.	Goatfishes (Red mullets)	3		3						
11.	Threadfins (Polynemids)									
12.	Croakers (Sciaenids)	1,263	4	1,267	2,512	229	2	3	234	395
13.	Ribbon fishes	26	1	27	25	8		6	14	17
14.	Carangids						7	17	24	
a.	Horse mackerel		2	2			2		2	
b.	Scads	66	2	68			14	9	23	58
c.	Leather-jackets *(Chorinemus)*					22	102	371	495	247
d.	Other carangids	39	18	57	104	25		20	45	54
15.	Silverbellies *(Leiognathus & Gazza)*	584	2	586	898	18			18	21
16.	Big-jawed jumper *(Lactarius)*	124		124	23					117
17.	Pomfrets				108		148	16	164	
a.	Black pomfret		21	21		4	6	6	16	
b.	Silver pomfret		2	2			9		9	
c.	Chinese pomfret									
18.	Mackerel	4	27	31	133	9	40	3,900	3,949	4,358
a.	Indian mackerel									
b.	Other mackerel									
19.	Seer fishes		21	21	346		205	1	206	266
a.	*S. commersoni*		58	58			9		9	
b.	*S. guttatus*									
c.	*S. lineolatus*									
d.	*Acanthocybium* sp.									1,277
20.	Tunnies		250	250	794		461	64	525	
a.	*E. affinis*		19	19			390		390	
b.	*Auxis* spp.									
c.	*K. pelamis*						7		7	
d.	*T. tonggol*		17	17			61	155	216	
e.	Other tunnies		13	13			30		30	
21.	Bill fishes					17	5	26	48	15
22.	Barracudas *(Sphyraena)*	42		42				67	67	37
23.	Mullets *(Mugil)*									
24.	Unicorn cod *(Bregmaceros)*									

Table 20 Contd.

25.		Flatfishes									
	a.	Halibut *(Psettodes erumei)*	60	1	61		11	1		12	
	b.	Flounders									
	c.	Soles	2,004		2,004	2,791	282			282	208
26.		Crustaceans									
	a.	Penaeid prawns	9,537		9,537	36,559	2,530		1	2,531	3,515
	b.	Non penaeid prawns									
	c.	Lobsters	3		3						
	d.	Crabs	74		74	4,167	38			38	86
	e.	Stomatopods	1,901		1,901		261			261	618
27.		Cephalopods	802		802	2,150	95			95	80
28.		Miscellaneous	1,809	14	1,823	3,939	161	40	6	207	314
		TOTAL	31,314	1,113	32,427	84,556	7,124	2,461	17,454	27,039	25,348
		No. of operations of fishing units	126,880	8,444		187,843	44,323	21,947	8,870		96,147

trawlers and gill netters was 233 and 159 kg. While the catch of perches, silverbellies and penaeid prawns from both increased by about 1,130, 1,030, 1,030 and 400 t respectively, croakers, elasmobranchs and flat fishes recorded reduced landings by about 500, 270 and 230 t respectively.

Cuddalore Fisheries Harbour

The total catch by trawlers and gill netters declined by about 900 t during 1981 (Table 19). The trawlers landed about 91 % of the total mechanised catch in 1981 and the rest by gill netters. The catch per unit effort for trawlers was 125 kg while that of gill netters 121 kg. The decline in the total mechanised catch was mainly due to reduced landings of silverbellies, perches and clupeoids by about 310, 170 and 130 t respectively.

Nagapatnam

The catch of trawlers during 1981 increased by about 1,900 t. (93%) Table 19). The number of operations of the trawlers also increased by about 6,500. The catch per unit effort during 1981 and 1980 was 245 and 216 kg respectively. Most of the species recorded improved catches during 1981, the major species that showed higher landings were silverbellies, croakers, penaeid prawns, clupeoids, flat fishes and elasmobranchs, the increase being about 310, 300, 240, 220, 90 and 90 t respectively.

Mandapam

The catch obtained from trawlers during 1981 was more than double as compared to 1980 (Table 19). The number of operations of the boats also increased by about 22,700. The catch per unit effort during 1981 increased to 114 kg from 101 kg recorded in 1980. The species which recorded higher landings during 1981 were silverbellies, penaeid prawns, croakers and elasmobranchs whose catches increased by about 1,600, 600, 200 and 150 t respectively.

Rameswaram

The total catch from trawlers and gill netters during 1981 increased by about 6,200 t, the bulk of the catch being from trawlers (Table 19). The catch per unit effort for trawlers and gill netters during 1981 was 203 and 101 kg respectively. Barring stomatopods and catfishes whose catch declined by about 150 and 100 t respectively, all the other major species recorded higher catches from both during 1981. The species that recorded higher landings were silverbellies, croakers, elasmobranchs, penaeid prawns, crabs and goat fishes whose landings increased by about 2,800, 1,300, 1,100, 700, 200 and 170 t respectively.

Tuticorin Fisheries Harbour

The total catch from both trawlers and gill netters during 1981 showed an increase of about 5,800 t (88 %) as compared to 1980, the bulk of the catch coming from trawlers (Table 19). While the catch per unit effort from trawlers was about 385 kg the same from gill netters was about 166 kg. The significant increase in the total catch of both during 1981 was due to higher catches of penaeid prawns, clupeoids and silver bellies, the increase in their landings being about 2,800, 1,800 and 1,200 t respectively. The landings of croakers, soles and elasmobranchs, however, decreased by about 300, 200 and 140 t respectively.

Sakthikulangara

The total catch by trawlers during 1981 decline by about 50,000 tonnes, the corresponding number of operations of fishing crafts also declined by about 46,000 (Table 20). The catch per unit effort also declined to 247 kg in 1981 from 470 kg recorded in 1980. The poor landings of prawns, perches, catfishes and croakers respectively by about 27,000, 11,000, 2,500 and 1,200 t were responsible for the sharp decline in the total catch.

Table 20. *Composition of marine fish landings from mechanised boats at major fish landing centres along the west coast of India (in tonnes)*

(Continued)

Sl. No.		Name of fish	Trawl net	Dol net	Gill net	Hooks & lines	Total	1980
			SASSOON DOCKS					
			1981					
1.		Elasmobranchs						1,337
	a.	Sharks	908	—	244	45	1,197	
	b.	Skates	38	—	—	2	40	
	c.	Rays	493	1	56	5	555	
2.		Eels	97	—	—	29	126	320
3.		Catfishes	1,720	4	1	252	1,977	2,196
4.		Clupeoids						
	a.	Wolf herring *(Chirocentrus)*	57	—	99	—	156	101
	b.	Oil sardine	68	28	—	—	96	3
	c.	Other sardines (Lesser sardines)	—	4	—	—	4	4
	d.	Hilsa shad *(Hilsa ilisha)*	—	—	—	—	—	1
	e.	Other shads (Other *Hilsa)*	—	2	95	—	97	84
	f.	Anchovies						
		Coilia	1,008	107	—	—	1,115	
		Setipinna	—	—	—	—	—	
		Stolephorus (Anchoviella)	—	—	—	—	—	17
		Thrissina	—	—	—	—	—	
		Thryssa (Thrissocles)	—	—	—	—	—	—
	g.	Other clupeoids	58	4	7	—	69	918
5.		Bombay duck *(Harpodon nehereus)*	18	441	—	—	459	365
6.		Lizard fishes *(Saurida & Saurus)*	334	—	—	—	334	358
7.		Half beaks & Full beaks *(Hemiramphus & Belone)*	—	—	—	—	—	—
8.		Flying fish	—	—	—	—	—	...
9.		Perches						1,802
	a.	Rock cods	20	—	—	—	20	
	b.	Snappers	22	—	—	—	22	
	c.	Pig-face breams	—	—	—	—	—	
	d.	Threadfin breams	1,018	—	—	—	1,018	
	e.	Other perches	34	—	2	4	40	
10.		Goatfishes (Red mullets)	37	—	—	—	37	39
11.		Threadfins (Polynemids)	130	—	—	1	131	353
12.		Croakers (Sciaenids)	4,135	76	—	21	4,232	2,984
13.		Ribbon fishes	1,364	33	1	—	1,398	1,865
14.		Carangids						

Table 20 Contd.

	a.	Horse mackerel	2	—	23	—	25	11
	b.	Scads	—	—	—	—	—	—
	c.	Leather-jackets	—	—	40	—	40	19
		Chorinemus						
	d.	Other carangids	56	—	—	—	56	38
15.		Silverbellies						23
		(Leiognathus & Gazza)						
16.		Big-jawed jumper						
		(Lactarius)						
17.		Pomfrets	3	—	—	—	3	334
	a.	Black pomfret	1	—	255	—	256	
	b.	Silver pomfret	59	27	138	—	224	
	c.	Chinese pomfret	—	—	—	—	—	
18.		Mackerel						
	a.	Indian mackerel	—	—	—	—	—	
	b.	Other mackerels	—	—	—	—	—	
19.		Seer fishes	45	—	179	—	224	143
	a.	*S. commersoni*	4	—	—	—	4	
	b.	*S. guttatus*	4	—	8	—	12	
	c.	*S. lineolatus*	—	—	—	—	—	
	d.	*Acanthocybium* Sp.	—	—	—	—	—	
20.		Tunnies		—		—		333
	a.	*E. affinis*	—	—	1	—	1	
	b.	*Auxis* spp.	—	—	—	—	—	
	c.	*K. pelamis*	—	—	7	—	7	
	d.	*T. tonggol*	—	—	—	—	—	
	e.	Other tunnies	41	—	500	—	541	
21.		Bill fishes	—	1	72	—	73	
22.		Barracudas *(Sphyraena)*	—	—	—	—	—	
23.		Mullets *(Mugil)*	—	—	—	—	—	
24.		Unicorn cod	—	—	—	—	—	
		(Bregmaceros)	—					
25.		Flatfishes	29	—	—	—	29	
	a.	Halibut *(Psettodes erumei)*	—	—	—	—	—	
	b.	Flounders	34	—	4	—	38	
	c.	Soles	386	—	—	—	386	236
26.		Crustaceans						
	a.	Penaeid prawns	6,171	121	—	—	6,292	5,001
	b.	Non penaeid prawns	251	1,066	—	—	1,317	1,093
	c.	Lobsters	82	—	—	—	82	98
	d.	Crabs	—	—	—	—	—	5
	e.	Stomatopods	—	1	—	—	1	—
27.		Cephalopods	859	—	—	—	859	635
28.		Miscellaneous	1	9	—	—	10	119
		TOTAL	19,587	1,925	1,732	359	23,603	20,835
		No. of operations of fishing units	21,540	13,999	4,533	1,617		37,462

The landings from gillnetters also declined by about 2,200 t. Both the number of operations and catch per unit effort declined in 1981 as compared to 1980 the former by 6,700 and the latter by 89 kg. The lower landings of catfishes, tunnies, elasmobranchs and seer fishes by 600, 500, 500 and 300 t respectively brought down the total catch.

Cochin Fisheries Harbour

The total catch from trawlers declined marginally by about 800 t. The number of operations and the catch per unit effort also declined marginally during 1981 as compared to 1980, the former by 1,800 and the latter by 11 kg. The landings of clupeoids, stomatopods, croakers, carangids and catfishes declined by about 620, 360, 160, 100 and 80 t respectively. Perches, however, recorded a substantial increase of about 1,600 t. (Table 20)

While the catch from gill netters declined by 100 t, the catch per unit effort showed an increase of about 48 kg, since the number of operations declined sharply by about 18,500. The lower total catch during 1981 was mainly due to reduced landings of tunnies by about 240 t. The catch of elasmobranchs and pomfrets, however, increased by about 80 and 50 t respectively.

The purse seiner landings during 1981 showed an increase of about 2,600 t. While the number of operations of the boats declined by 710, the catch per unit effort increased by about 417 kg. The landings of clupeoids increased by about 2,300 t and of mackerel declined by about 320 t.

Sassoon Docks

During 1981, mechanised boats operated with trawl nets, dol nets, gill nets and hooks and lines in Sassoon Docks, the combined catch for all the gears being 23,603 t as compared to 20,835 t in 1980, showing an increase of about 2,800 t (13%) (Table 20). The bulk of the mechanised catch during 1981 was from trawlers (83%), the rest being from dol nets (8%), gill nets (7%) and hooks and lines (2%). Comparatively higher landing of penaeid prawns, croakers and non penaeid prawns during 1981 contributed to the higher catch in the year, the increase in their landings being 1,300, 1,250 and 220 t respectively. The catch of perches, however, showed a decline.

Compiled and prepared by M. J. George, S. K. Dharmaraja & G. Subbaraju.
Published by Dr. M. J. George, Senior Scientist on behalf of the Director, Central Marine Fisheries Research Institute, Cochin-682 018 and printed at PAICO, Cochin-31

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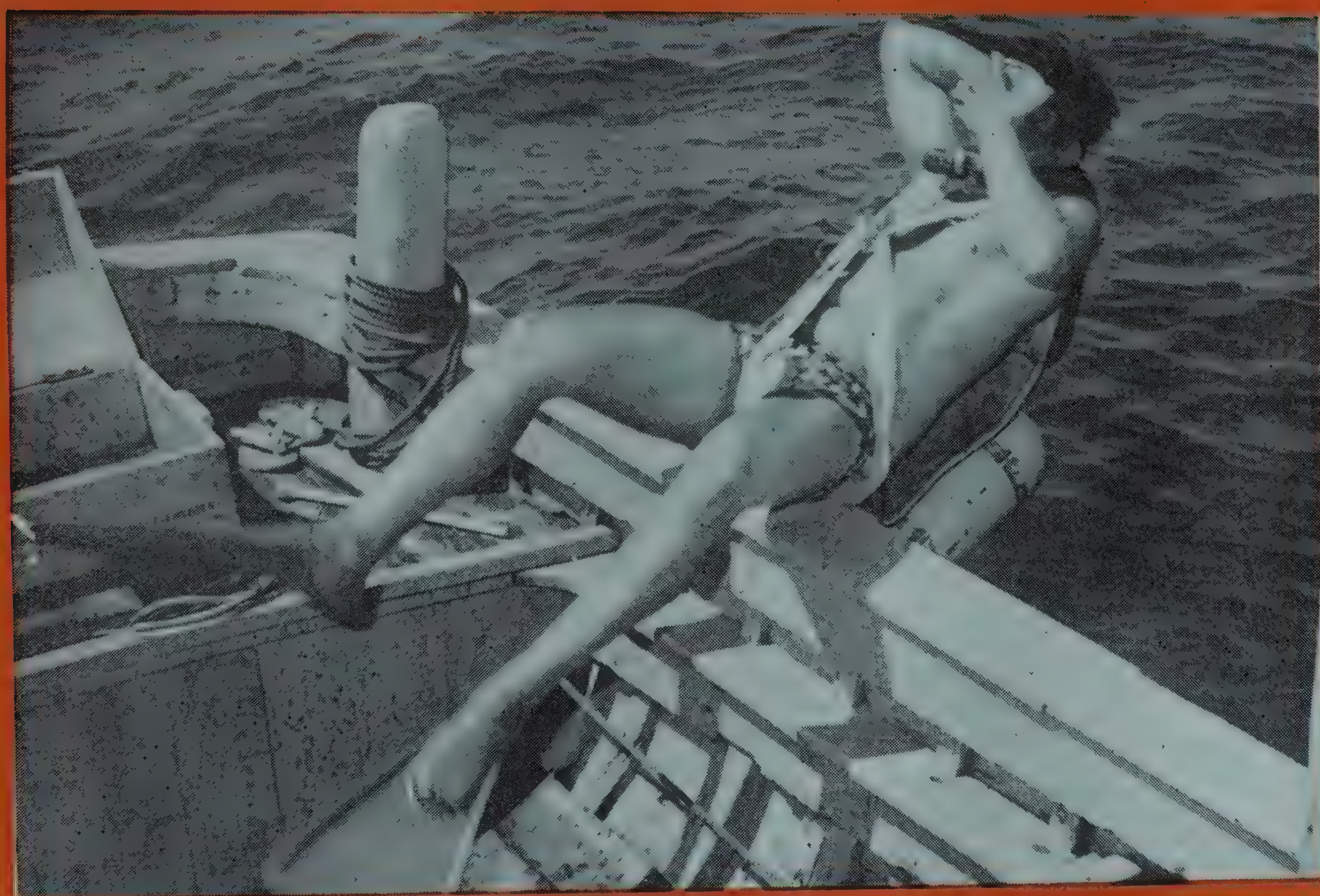

Technical and Extension Series

No. 42
SEPTEMBER, 1982

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THE MARINE FISHERIES INFORMATION SERVICE: Technical and Extension Series envisages the rapid dissemination of information on marine and brackish water fishery resources and allied data available with the Fishery Data Centre and the Research Divisions of the Institute, results of proven researches for transfer of technology to the fish farmers and industry and of other relevant information needed for Research and Development efforts in the marine fisheries sector.

Abbreviation — *Mar. Fish. Infor. Serv. T & E Ser., No.* 42: 1982.

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Cover photo: Scuba diver taking the leap.

SCUBA DIVING INVESTIGATIONS AND TRAINING

S. Mahadevan and K. Nagappan Nayar, Tuticorin Research Centre of Central Marine Fisheries Research Institute.

Introduction

Diving activity in sports and recreation acquired great popularity during the last three decades due to the new dimension given by Cousteau-Gagnan in 1942 by perfecting the 'Aqua-lung'. For the first time it was possible for man to experience a three dimensional space, diving with self-contained underwater breathing apparatus, popularly called SCUBA. This method of free diving opened up a new vista for scientists exploring the under-sea world by periodically organising excursions to study, photograph and collect materials. During the past 35 years underwater technology, engineering, bio-medicine, saturation diving and automation had developed tremendously to enable man to forge to very great depths in to the oceans and stay there for extensive periods. Sea city plans, off-shore living space, habitats, sea-labs etc. have been successfully experimented upon as a result of recent advances in the technology of diving. Inspite of all these aqua-lung diving continues to be very useful for scientists searching for specific underwater details, in photography, for collections and observations in the shallow limits of ocean beds. The very nature of the cheap cost of possessing and operating the aqua-lung makes it easy for developing countries to introduce this system of diving for scientific exploration programmes.

Diving with aqua-lung for scientific investigations, however, came into the field in India only in the late 1950's due to the joint efforts of the Central Marine Fisheries Research Institute and the Tamil Nadu Fisheries Department. Necessity arose to look for a satisfactory method of exploring the sea-beds in the Gulf of Mannar for locating and charting the pearl oyster beds and chank beds towards better management of these fisheries. The age-old method of commercial exploitation of these by a section of fishermen by skin diving upto 25 m depth left much to be improved in as much as it is laborious and tiresome. It needed modification by introducing diving with aqua-lung towards greater efficiency and ease. By creating a cadre of trained personnel in this field of activity and developing adequate infrastructure facilities a phased programme of change in the old system was felt necessary. A project jointly sponsored by the Government of India and Government of Tamil Nadu sought the technical assistance for expertise and equipment from FAO, Rome in 1958. The terms of reference for this project assistance by FAO envisaged (a) selection of equipment useful for studying the sea-bottom upto 30 m depth (b) training of Indian scientists in the modern methods of diving (c) carrying out accurate diving survey of areas containing pearl oyster and chank population to obtain precise information about the location and extent of each bed and knowledge of the ecological conditions and (d) to chalk out a long range programme of training, management and development of pearl and chank fisheries in these areas.

The F A O placed the services of Dr. F. Baschieri Salvadori, an expert diving scientist for this assignment who brought with him 6 pairs of aqua-lungs, 2 portable compressors 'Nereus' 1958 with ('continental' motors, diving accessories) and a 'Rollei Marin' Camera for underwater photography. The expert started project work at Tuticorin in November 1958 and completed his first assignment in May 1959. During this period he imparted aqua-lung training to six Indian scientists and gave training to two professional divers. He also undertook a rapid inspection of 33 pearl banks and a few chank beds. However, detailed survey of only four pearl banks (Paars) was completed by him. This enabled him to outline the contours of these areas, locate their position, calculate the extent of each paar, study the faunistic and floral features of the areas covered. A report embodying the details of work done and the results of his technical programme was brought out by the FAO in Report No. 1119-EPTA (1960) submitted to the Government of India. Since much remained to be completed after his first assignment, Dr. Salvadori was reassigned to visit India again twice for short spells during November-December 1960 and December 1961 to February 1962. During his second visit he initiated survey work of sea-bottom from 10 m depth to 26 m depth. His second report to Government of India, EPTA No. 1323, published by FAO in 1961 is very brief and outlines only the plan of work and the facilities needed. During his third and last visit he comple-

ted training of two more scientists in SCUBA diving and evaluated the progress of work till 1961. These are reflected in his third report, EPTA No. 1498, published by FAO, in 1962.

SCUBA diving in CMFRI

The training given to two scientists of CMFRI and two from the Tamil Nadu Fisheries Department and the experience gained in underwater exploration made it possible for them to carry out a phased programme of sea bottom survey during the next three years 1962-1964. The CMFRI imported six pairs of aqua-lungs ('Siebe-Gorman' make), important diving accessories, and a 'Rollei Marin' Camera to supplement the FAO equipment left with the Department of Fisheries, Tamil Nadu. Later, CMFRI acquired an electrically operated air compressor (Bristol' Co.), one portable air compressor (Sachs-Bauer-Utilus) and one more underwater camera - 'Calypso'. Thus the sustained interest evinced by the Institute to promote this discipline of scientific work enabled the scientists engaged in this project not only to acquire very valuable diving experience but also facilitated collection of useful data on the pearl oysters and chank, in the study of the ecological features of the sea bed off Tuticorin and estimation of the density of chank and oyster population in different localities investigated. The results of these studies were published (ref: list of publications).

Since marine fishing industry as well as industries based on marine products need as much of authentic information as possible in all matters connected with raw material availability, seasons and areas of abundance and expert consultancy on rational exploitation possibilities the expertise available is being provided by the CMFRI within the framework of its research objectives and time availability. One such assignment was the survey of Andamans and Nicobar Islands for assessing potentialities of these areas for mariculture purposes. For the first time a pioneering attempt was made during February-April 1978 to investigate the nearby coastal areas of nearly 27 of these islands by aqua-lung diving by the scientists of this Institute. The report and recomendations are being published. Another noteworthy contribution by the diving scientists team of CMFRI was the detailed survey of 20 islands in the Gulf of Mannar during 1978-80 and exploration of the fringing coral reefs and adjacent areas (Fig. 1-20) to determine the extent of damage done to the reefs and reef fauna by human interference and destructive fishing activities. This survey helped to outline conservation measures to protect endangered species based on which the creation of a 'Marine National Park' in the Gulf of Mannar was proposed by the Institute. This objective study was fully appreciated and accepted by the Government.

Training Programme

In order to promote 'SCUBA' diving for scientific and exploratory purposes and for exploitation of marine resources the Institute decided upon a programme of training scientists and technical personnel in aqua-lung diving. Towards facilitating this, additional diving equipment and accessories have been imported recently to substitute and supplement the existing ones. This training was initiated in 1979-80 at Tuticorin under the leadership of the two experienced scientists of the Institute. Scientists and technicians are eligible for this training. Two batches of scientists and other staff were trained during 1979-1981 (Fig. 21-24).

The training course imparts theoretical and practical lessons and runs for a period of 8 weeks. Two sessions are possible in each year. Selection of candidates is done after obtaining proof of their physical fitness as certified by competent medical authority and the selected candidates are required to get their lives insured by the sponsoring authorities or institutions for the duration of the training course.

The Institute does not undertake any financial commitment. Stay, food and medical expenses of the candidates so selected for training will have to be borne by the sponsors. The expertise offered by the CMFRI is free and on the successful completion of the course a testimonial of proficiency in SCUBA diving will be given to each candidate within the limits contemplated by the project objectives.

A broad outline of training schedule is given for the benefit of those interested in the training.

Training Schedule

Theory 20 Hours

Snorkeling: Basic rules and pre-requisites-pressure and skin diver equalising middle ear pressure-Deep dive techniques.

Fig. 1. Observations and gathering materials at the sea bottom.

Fig. 2. On the look-out for warding off possible danger from barracudas passing nearby.

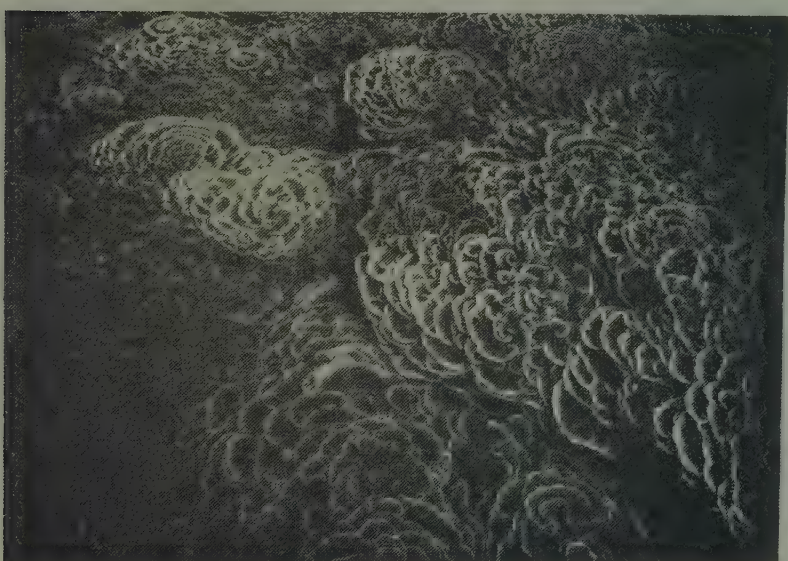


Fig. 3. An extensive Montiporan coral colony in the clear subtidal areas in the vicinity of Tuticorin shore line.

Fig. 4. Assemblage of live corals in the deeper zones.

Fig. 5. Massive coral blocks and brittle coral colonies.

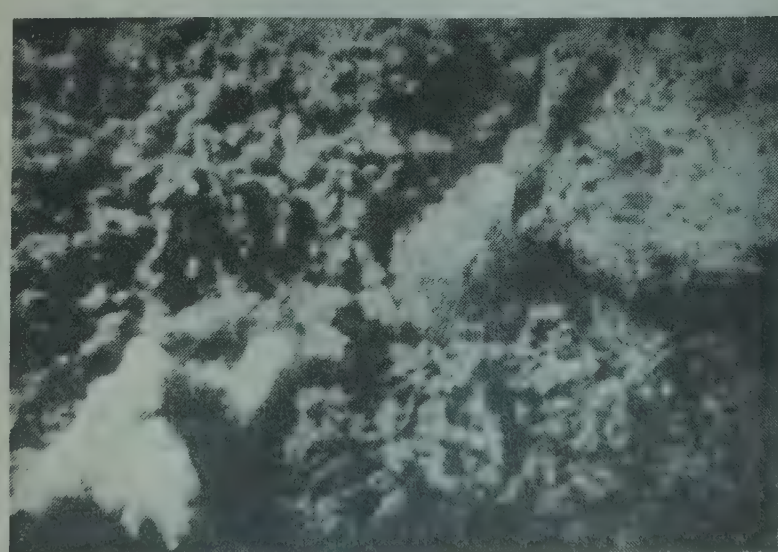


Fig. 6. Solitary coral, *Fungia* sp. over rocky substratum.

Fig. 7. Encountering sea snakes at the bottom is a common feature.

Fig. 8. A giant rock lobster, *Panulirus* sp., caught from a ledge, being brought up.

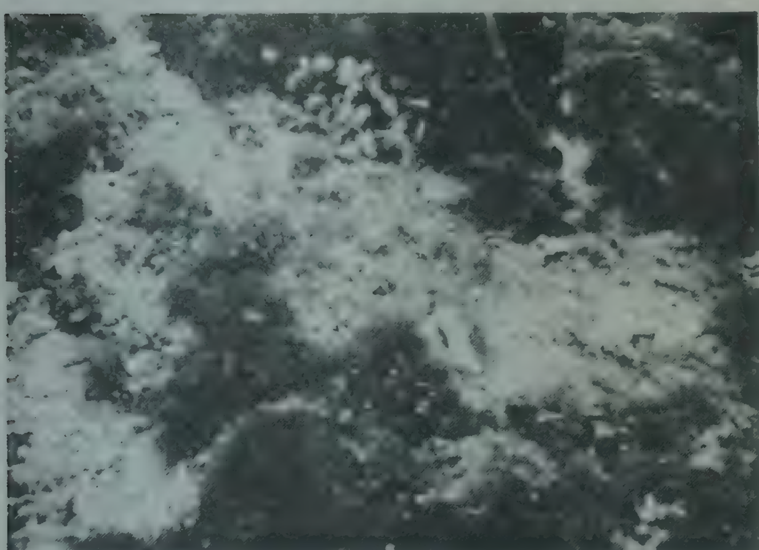


Fig. 9. A rugged sponge and seaweed covered rocky bed.

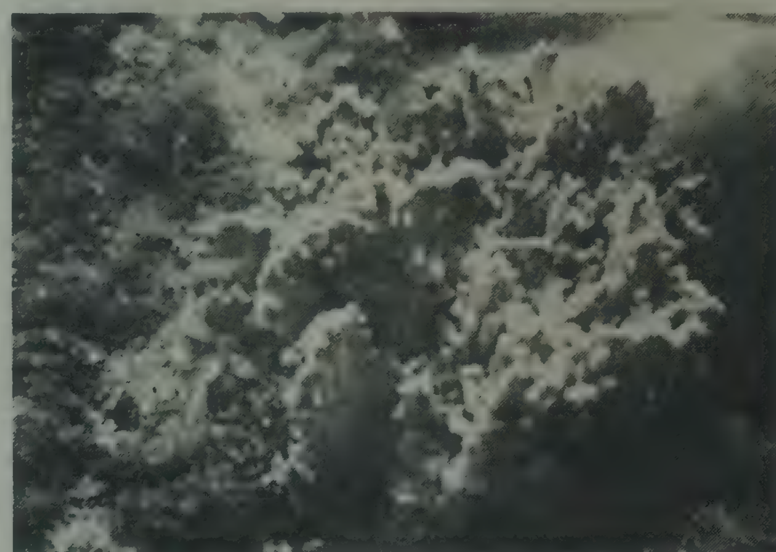


Fig. 10. Sponge colonising the rocky bottom.

Fig. 11. Massive sponge. *Petrosia* sp. with coral fishes hovering round.

Fig. 12. Montiporan coral block providing hiding cover to *Gaterin* sp.

Fig. 13. A large sea anemone, *Amphiprion*, the damsel fish and *Serranus miniatus*, the red rock cod taking refuge alongside a sponge ridge.

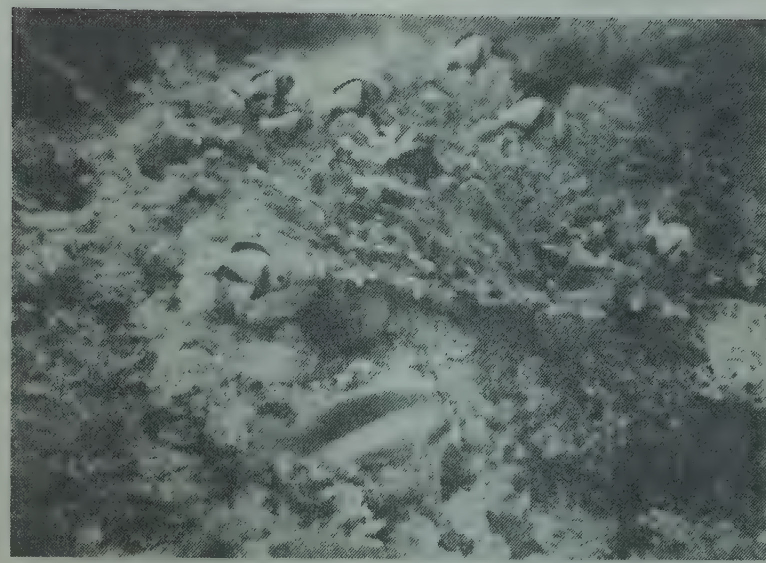


Fig. 14. Coral reef fish community.

Fig. 15. Dense seaweed growths characteristic of the rocky sea floor off Tuticorin.

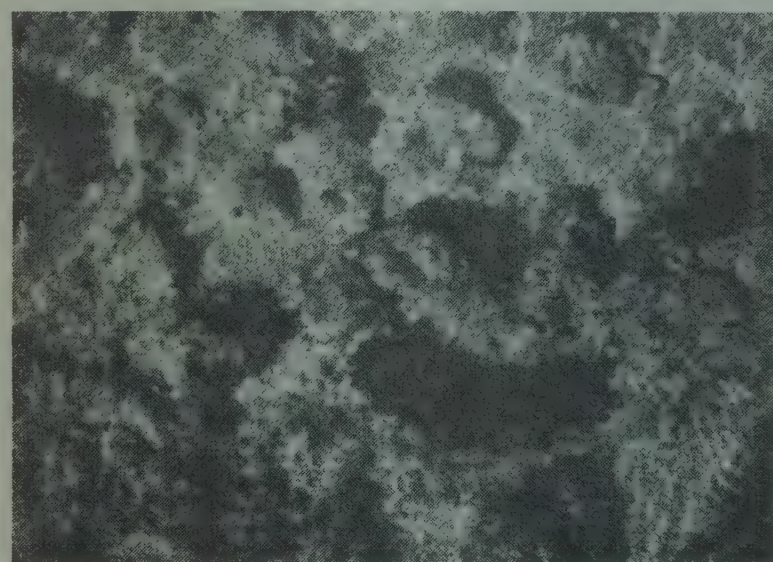


Fig. 16. Black holothurian on rocky bed.

Fig. 17. *Scolopsis vasmeri*, a common fish at the pearl oyster beds.

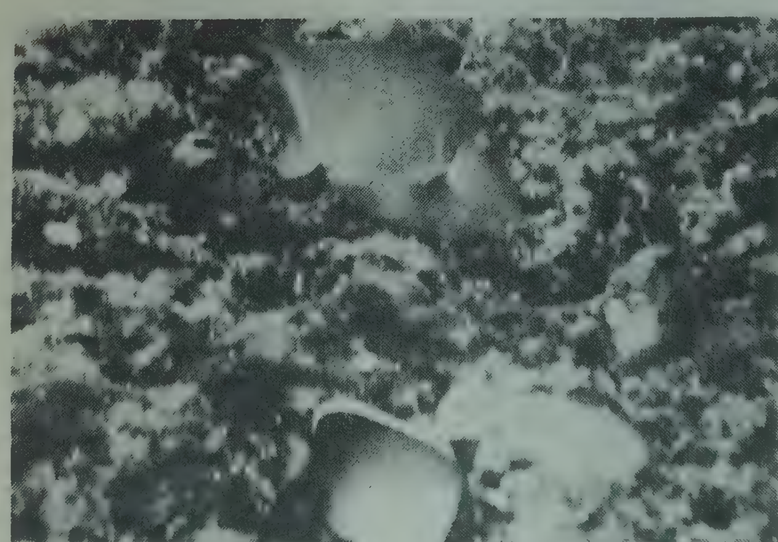


Fig. 18. *Balistes* sp., the file fish is the most characteristic denizen of pearl oyster beds.

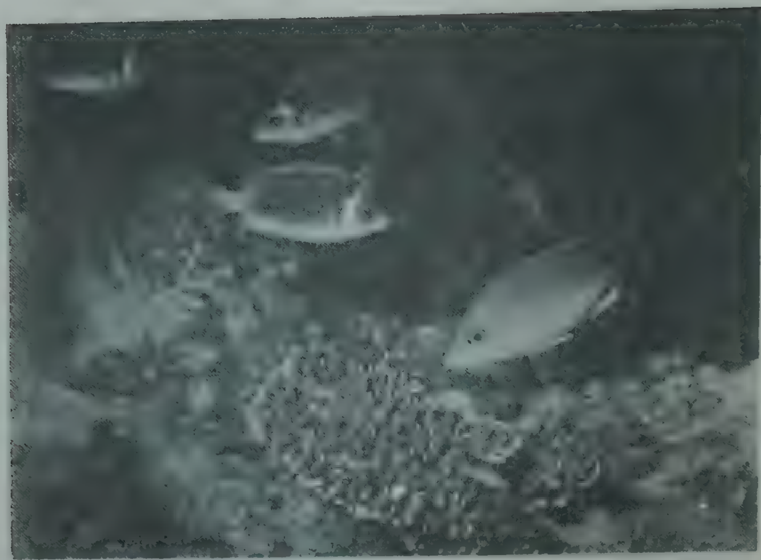


Fig. 19. These fishes are numerous in the pits and crevices of pearl beds.

Fig. 20. The rock cod, *Serranus miniatus*, is ubiquitous from 10 m–25 m in the rocky areas.

Fig. 21. 'SCUBA' diving training team with trainees from CMFRI.

Fig. 22. Training lessons in putting on Aqua-lung and positioning.

Fig. 23. The plunge into deep sea.

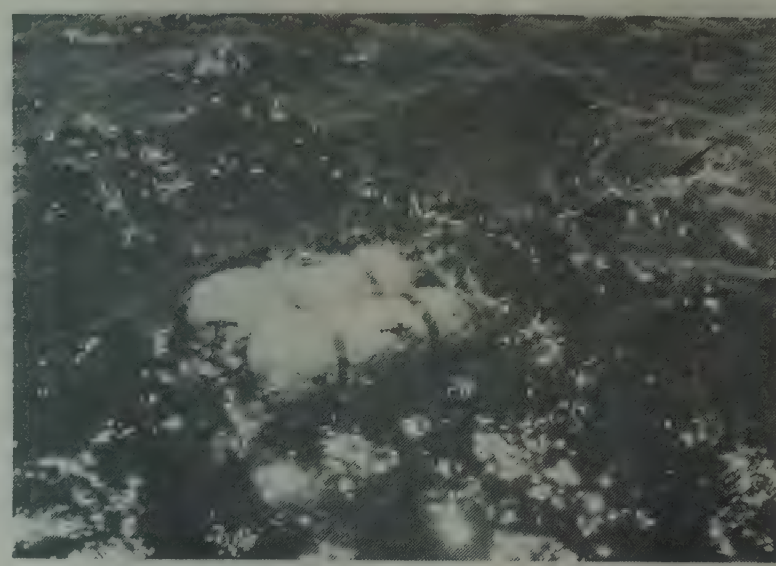


Fig. 24. 'SCUBA' diver in the process of descent.

Diving equipment: Make and selection of mask, fins, snorkel and knife-use and care of depth gauge, floats, watch, compass, suits, boats for divers-torch, camera, underwater guns, spear etc.

Diving: Where to dive-visibility-sea diving.

Aqua lung: What is aqua-lung-effect of pressure-hazards in diving-Symptoms of diving diseases-safety while diving-Decompression-Demand value regulator-functioning and uses-Types of regulatorr breather.

How to use aqua-lung-emergency procedures in diving-clearing of flooded mask, breathing tube, clearing mouth piece etc. Precautions with the equipment while diving.

Deep dive: Skin diving and safety-Buddy system-Diving signals–artificial respiration–do's and don'ts while diving with aqua-lung. Maintenance of aqua-lung and regulators.

Skin diver and marine life: Fish watching. Psychology of fish-senses of fish. Sharks and attacks-collection techniques at sea bottom-Dangerous marine life–Underwater photography.

Model gadgets in diving: Underwater vehicles and other recent advances in sea bottom studies by direct observation.

Practical 100 Hours.

Surface swimming with and without fins-swimming underwater with fins and mask-snorkeling in shallow areas and deeper areas-skin diving in shallow areas and slightly deeper areas-rescue operations while diving-artificial respiration.

Care of diving equipment and accessories-functioning of portable and electrical compressors-charging aqua-lungs-dismantling and assembling of lungs and regulator.

Exercises in removal of aqua-lung and replacing while diving at shallow water-clearing of flooded mask, breathing tubes-exchange of mouth piece with partner while diving-deep water diving with aqua-lung-collection of materials-use of different collection tools-confidence level diving.

Period of Training:		December to April
Place	:	Tuticorin
No. of Trainees per Session	:	Eight

List of scientific publications in underwater diving observations by CMFRI

1. George, M. J., K. Nagappan Nayar and S. Mahadevan. 1967. Underwater observations. On a collection of shrimps from the Gulf of Mannar off Tuticorin. *Rec. Zool. Surv. India* **67**: 357-365.

2. Mahadevan, S. 1961. The pearl fish *Carapus margaratifera* (Rendahl), a new record for the Indian waters. *J. mar. biol. Ass. India.* **3** (1 & 2): 204-207.

3. Mahadevan, S. and K. Nagappan Nayar. 1965. Underwater ecological observations off Tuticorin in the Gulf of Mannar. Association between a fish (*Gnathonodon*) and a sea snake. *J. mar. biol. Ass. India* **7** (1):1-3.

4. Mahadevan, S. and K. Nagappan Nayar. 1965. Underwater ecological observations off Tuticorin in the Gulf of Mannar. On the emperor bream, *Lutianus sebae* found with Pterois, the scorpion fishes. *J. mar. biol. Ass. India* **7** (2).

5. Mahadevan, S. and K. Nagappan Nayar. 1965. Note on the habitat and distribution of the file-fishes along the Tuticorin coast. *J. mar. biol. Ass. India* **7** (2). notes.

6. Mahadevan, S. and K. Nagappan Nayar. 1966. Underwater ecological observations in the Gulf of Mannar, off Tuticorin. VI. On the habitat, movements and breeding habits of the chank, *Xancus pyrum* (Linnaeus). *J. mar. biol. Ass. India* **8** (1): 213-218.

7. Mahadevan, S. and K. Nagappan Nayar. 1967. Underwater ecological observations in the Gulf of Mannar, off Tuticorin. VII. General topography and ecology of the rocky bottom. *J. mar. biol. Ass. India* **9** (1): 147-163.

8. Mahadevan, S. and K. Nagappan Nayar. 1971. Whither

pearl fishing. Souvenir Fish Exporters Chamber 181-184.

9. Mahadevan, S. 1971. Fishing for pearls in India. Sea-Food Export Jour. **3** (3): 23.

10. Mahadevan, S. and K. Nagappan Nayar. 1972. Free diving in Indian waters. Sea Food Export Jour. **4** (2): 25-27.

11. Mahadevan, S. and K. Nagappan Nayar. 1973. Pearl oyster resources of India. Proc. of the Symposium on the living resources of the seas around India: 659-671.

12. Mahadevan, S. and K. Nagappan Nayar. 1974. Ecology of the pearl oyster and chank beds. *Bull. of C.M.F.R.I.* No: 25: 106-112.

13. Mahadevan, S. and K. Nagappan Nayar. 1976. Underwater observation on the settlement of pearl oyster spat in the paars off Tuticorin. *Indian J. Fish.* 23: 105-110.

14. Mahadevan, S. 1979. Possibilities of mussel culture in Andaman Islands (ms).

15. Mahadevan, S. and D. C. V. Easterson. 1979. Topographical and ecological features of Andaman and Nicobar Islands with special reference to their suitability for mariculture activities (ms).

16. Nayar, K. Nagappan and S. Mahadevan. 1965. Underwater ecological observations off Tuticorin in the Gulf of Mannar. The occurrence of the synaptid *Chondrocloea* along with the massive sponge, *Petrosia. J. mar. biol. Ass. India.* **7** (1)

17. Nayar, K. Nagappan and S. Mahadevan. 1965. Underwater ecological observations off Tuticorin in the Gulf of Mannar. The occurrence of Crinoids (*Lamprometra* and *Comanthus*) on the gorgonid *Juncella. J. mar. biol. Ass. India* **7** (2).

18. Nayar, K. Nagappan and S. Mahadevan. 1965. Underwater ecological observations off Tuticorin in the Gulf of Mannar. On sea anemones and the fishes *Amphiprion* and *Dascyllus* found with them. *J. mar. biol. Ass. India* **7** (2).

19. Nayar, K. Nagappan and S. Mahadevan. 1967. The pearl and chank fisheries-A new outlook in survey and fishing. Souvenir: 20th Anniversary, Central Marine Fisheries Research Institute.

20. Nayar, K. Nagappan and S. Mahadevan. 1973. Chank resources of India. Proc. of the Symposium on the living resources of the seas around India: 672-686.

21. Nayar, K. Nagappan and S. Mahadevan. 1974. Chank fisheries and industrial uses of chanks. Bull of C.M.F.R.I. No. 25: 122-140.

22. Nayar, K. Nagappan and S. Mahadevan. 1976. On the settlement and collection of pearl oyster spat from Tuticorin area (ms). *Indian J. Fish.*

23. Silas, E. G., et al. 1977. Report on the survey of the islands in the Gulf of Mannar by C.M.F.R.I. for the setting up of a Marine National Park. C.M.F.R.I. Publication: (MS).

PRAWNS IN PURSE SEINE CATCHES*

Introduction

With the recent introduction of purse seine fishing along Karnataka and Kerala coasts there has been considerable improvement in the catches of pelagic shoaling fishes such as oil sardine and mackerel from these waters. In Karnataka state the purse seiners are operated mostly in South Kanara, centred around Mangalore, Malpe and Gangoli, the total number of purse seiners in operation in these centres rising to 261 during the last 4–5 years. At Cochin Fisheries Harbour, the only centre from where purse seines are operated in Kerala, there is a substantial landing of oil sardine, mackerel and other fishes like carangids by this gear, numbering about 60 in 1981.

The total estimated landings by purse seines at Cochin for the year April 1981–March 1982 was 17,050 tonnes, of which the Indian oil sardine *Sardinella longiceps* contributed 13,949 t forming 81.81% of the total catch, the Indian mackerel *Rastrelliger kanagurta* formed 1,836 t constituting 10.77% followed by carangids composed mainly of *Alepes kalla, A. djeddabba, Megalaspis cordyla* and *Scomberoides tol* contributing 399 t forming 2.3% of the total catch. At Mangalore the total landings by purse seines in 1981 were 42,269 t of which 27,215 t were contributed by oil sardine, 3,960 t mackerel, 3,990 t cat fishes, 2,322 t anchovies, 1,961 t tunnies, 1,635 t carangids and the rest other miscellaneous fishes. Prawns being demersal in habit, occur rarely in purse seine catches. But during 1981 and especially in 1982 on a few days unprecedented catch of prawns, contributed mostly by a single species, was noticed in the purse seine operations both in Kerala and Karnataka (Fig. 1–6). A study of these prawns occurring in purse seine catches has been attempted.

Prawn catches in purse seines at Cochin

On 28 th and 29 th April, 1982 unusually heavy landings of prawns were noticed in some purse seines operated by 42′ vessels with 110 Hp engines, south west off Cochin at a depth range of 15–20 m. The prawn catch, composed exclusively of *Metapenaeus dobsoni* (Poovalan chemmeen), was estimated at 67,990 kg on 28.4.82 with the catch per unit fluctuating between 1,000 and 1,800 kg, the mean catch per unit per day being 1,133 kg. On 29.4.82 the intensity of the prawn catch dwindled, with the landings coming down to 33,070 kg with an average catch per unit of 601 kg. The oil sardine was also landed in good quantities on these days.

*Prepared by K. V. Somasekharan Nair, A. A. Jayaprakash, K. K. Sukumaran, K. Y. Telang and K. K. Balasubramanian with the guidance of M. J. George.

Table 1. *Prawn (Metapenaeus dobsoni) catches (in kg) by purse seiners at Fisheries Harbour, Cochin.*

Date	No. of units operated	Average catch of prawns per unit	Estimated total catch	Estimated value in Rupees
19.12.81	62	1.59	99	860
21.12.81	55	2.16	119	1,100
22.12.81	55	2.54	140	1,250
24.12.81	40	3.22	129	950
28.12.81	52	2.57	134	1,075
1..1..82	53	84.90	4,500	65,000
4..1..82	55	19.20	1,056	7,300
20.1..82	55	65.45	3,600	30,600
4..2..82	8	128.75	1,030	8,500
18..2.82	52	60.57	3,150	24,410
28.4..82	60	1,133.16	67,990	5,33,780
29.4..82	55	601.27	33,070	2,84,400

Fig. 1. A carrier boat full of *M. dobsoni* at Malpe (2-9-82)

Fig. 2. Prawns being sorted on board a carrier boat.

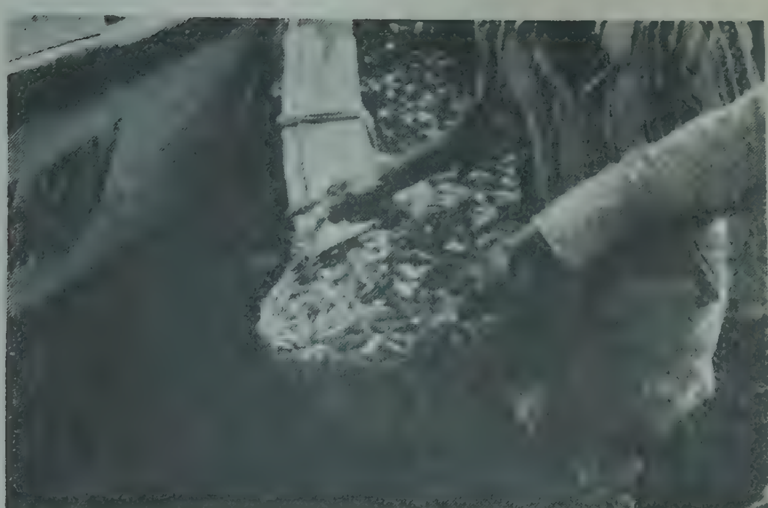


Fig. 3. Unloading of *M. dobsoni* at Malpe from a purse seiner on 2-9-82.

Fig. 4. *M. dobsoni* at Malpe unloaded in baskets for transportation on 2-9-82.

Fig. 5. Catches being unloaded from a carrier boat at Fisheries Harbour, Cochin.

Fig. 6. Baskets of *M. dobsoni* unloaded from purse seiners.

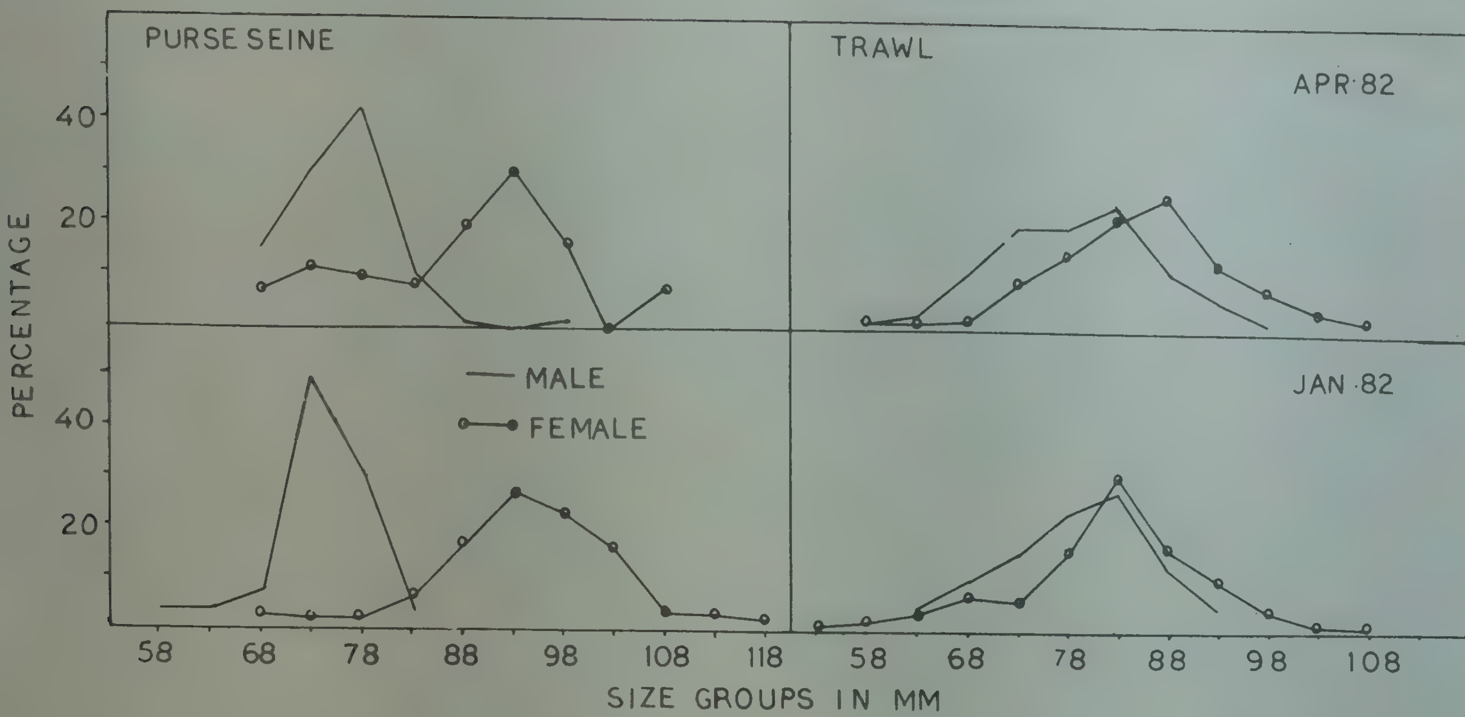


Fig. 7. Length frequency distribution of *M. dobsoni* in purse seine and trawl catches at Cochin.

On previous occasions also prawns have been caught in purse seines. For example on 1-1-82 two carriers of a purse seiner landed an estimated catch of 4,500 kg of *M. dobsoni*, which was auctioned at Rs. 65,000/-. It was interesting to note that apart from the single purse seine unit and its carriers, all other purse seine units and carriers on that day landed only oil sardine and carangids. The occurrence of *M. dobsoni* in appreciable quantities in the purse seines has been noted on few previous days also as may be seen from table 1. However, the maximum catch was recorded on 28 th April 1982. Females dominated in the purse seine catch in a ratio of 57:43, with the mature and late mature specimens forming 66% of the female population.

Size composition: Length measurements of random samples of *M. dobsoni* from purse seine landings of 1-1-82 revealed that the total length ranged from 55 to 85 mm for males with the dominant mode at 71-75 mm group and from 65 to 120 mm in females with the mode at 91-95 mm. On 28-4-82 the size ranged from 66 to 100 mm with the mode at 76-80 mm for the males, whereas the size range for the females was between 66 and 110 mm with the mode at 91-95 mm (Fig. 7). The size range and model sizes of the same species of prawn caught in the trawl nets from the same area and during the same period are also shown in the figure.

Purse seine prawn catches in Karnataka

In early September 1982, on resumption of fishing activities after the southwest monsoon, very large quantities of prawns were caught in purse seines operating at Mangalore and Malpe within the 15 m depth zone. On first 3 days of the month the catches were very high, showing a steep fall afterwards and disappearing by 8 th September. The catches of prawns by this gear during the period is estimated at 440.4 t and 320.9 t respectively at Mangalore and Malpe (Table 2), worth about 16 million rupees. In the previous two years also in September prawns were landed by purse seines at these centres. In 1980 the purse seine catches of prawns during the period were 395 t and 122.2 t in Mangalore and Malpe respectively and in 1981 much less, being 6.6 t and 15.0 t respectively at these two places. At Gangoli, situated about 60 km north of Malpe, it was surprising to note that there was very little catch of prawns in purse seines during the month, 2 t of prawns being landed only on 8 th September. At Karwar also prawns were landed by purse seines in September.

As at Cochin *M. dobsoni* (Poovalan) contributed to the bulk of the heavy catch, 98.3% and 93.3% respectively at Mangalore and Malpe. The rest of the catches constituted *Penaeus indicus* (Naaran), the Indian white prawn. However, on the first 3 days when there was very high catch

Table 2. *Prawn catch (in tonnes) in different gears during 1-8 September 1982 at Mangalore and Malpe (percentage of prawns in paranthesis)*

	Mangalore Purse seine	Mangalore Trawl	Mangalore Total	Malpe Purse seine	Malpe Trawl	Malpe Total
Number of units	816	1,560		754	1,547	
Total prawns	440.4	269.9	710.3	320.9	110.0	430.9
c/u in kg.	539.7	173.0		425.6	71.1	
M. dobsoni	432.8 (98.3)	257.1 (95.2)	689.9 (97.1)	299.5 (93.3)	108.6 (98.7)	408.1 (94.7)
P. indicus	7.6 (1.7)	12.8 (4.8)	20.4 (2.9)	21.4 (6.7)	1.4 (1.3)	22.8 (5.3)

M. dobsoni formed almost 100% of the landings. More or less the same ratio of sex distribution as at Cochin was noticed at both Mangalore and Malpe, the female to male ratio being 56:44. Around 67% of females were in spent/spent recovering stages at Mangalore and at Malpe these stages formed 42.4%. The mature and impregnated females were 22.7% and 24.4% respectively at Mangalore, while at Malpe these were 34.6% and 38.4% respectively.

Size composition: In comparison to the sizes landed at Cochin during the pre-monsoon period the sizes occurring in the purse seines at Mangalore and Malpe were much higher, mainly supported by the 1 year class and above. The sizes ranged from 76 mm to 105 mm with modal length at 91-95 mm in males and from 81 mm to 120 mm with mode at 106-110 mm in females at Mangalore. At Malpe the size ranged from 86 mm to 100 mm with mode 91-95 mm group and 91 mm to 120 mm with mode at 106-110 mm for males and females respectively, (Fig. 8). Thus the modal lengths of the species in the catches at both centres are the same. The size range and modal sizes of *M. dobsoni* caught in the trawl nets from Mangalore and Malpe during the same period are depicted in figure 2 for the sake of comparison.

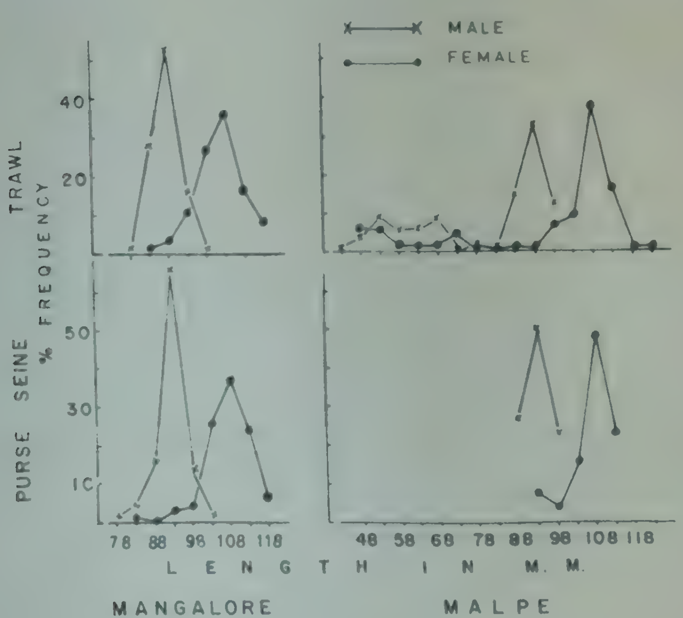


Fig. 8. Length frequency distribution of *M. dobsoni* in purse seine and trawl catches at Mangalore and Malpe.

General remarks

The sporadic occurrence of prawns in the purse seine catch on certain days appears to be brought about by the behaviour of the species. The coming up of prawns in the column of water during southwest monsoon due to upwelling nearer the shore and the resultant mud bank prawn fishery in the Ambalapuzha-Thottapally and Valappad-Nattika region of Kerala coast has been reported earlier. It has also been recorded that the pattern of fish and prawn distribution in the fishery changes due to the shoaling behaviour of the component species. However, such occurrences of prawns in the column of waters were reported during the southwest monsoon period and the present report of similar behaviour and consequent incidental catches in the purse seines in the pre-monsoon period at Cochin and immediately after the monsoon along Karnataka coast is interesting. It is quite possible that the behavioural pattern of the prawn is not dependent on upwelling.

Analysis of the sizes of the species of prawn represented in the purse seine catches in comparison to the sizes occurring in the trawl fishing grounds of the area during the same period gives certain interesting results. At Cochin a study on this line (Fig. 7) shows certain differences between the modal sizes in the two different gears, although the range in sizes is similar. The dominant size groups which are 71-75 mm in purse seine catches showed 81-85 mm in the trawl catches in the case of males, while in females they are 91-95 mm in the former and 81-90 mm in the latter. Thus the females show a higher modal length in purse seine catches while males show a lower modal length in the same when compared to trawl catches. The purse seine catches being dominated by females, the larger sizes of these females and majority of them with maturing and mature gonads would probably indicate that this behaviour of the shoals coming up in the column of water may have some connection with their spawning.

A similar analysis of the sizes of prawns represented in the purse seine and trawl catches of Karnataka coast (Fig. 8) gives a slightly different picture. The modal sizes of the prawns in the catches of both the gears in males as well as females are exactly the same in both centres, although the trawl catches at Malpe shows a much wider range in sizes when compared to the purse seine catches. Further the modal sizes of both males and females are much higher than that in the catches at Cochin. This is probably brought about by the difference in season, the reported occurrence of purse seine catches at Cochin being in January-April period and that at Mangalore and Malpe in September. However, the dominance of females in the purse seine catches of this coast along with the fact that majority of them were in spent/spent recovering stages would strengthen the point that the behaviour of the shoals moving up in the column of water is probably related with their spawning activities.

The large sizes of *M. dobsoni* occurring in the purse seine catches, particularly at Mangalore and Malpe would indicate that the population exploited consists of prawns at almost the fag end of their life and it appears that unless exploited at that time they may possibly perish due to natural mortality, especially since specimens larger than these sizes were seldom encountered in the fishery of the species any where along the coast. The occurrence of dead and decayed prawns of this species in the trawl catches during the season and large scale occurrence of shells and shell pieces noticed in the beaches and surf areas in the nearby coasts of Mangalore and Malpe towards the end of the monsoon season tend to support this view. Therefore, this seasonal exploitation of these large size prawns by purse seines may not pose any conservation problem. Though the occasional landings of prawns by purse seines at Cochin also need not be of much concern from the management point of view of prawn fishery in view of the sporadic nature, a close monitoring of purse seine catch is essential to see that purse seining does not affect the coastal trawl fishery that depends mainly on the penaeid prawn resources.

NEWS-INDIA AND OVERSEAS

Large scale destruction of turtles in West Bengal.

Destruction of turtles on a mass scale was noticed at Digha and Banksalghat in Midnapur district in West Bengal during 1981-82 season from about mid-November 1981 to February 1982. Actually the capture of these turtles took place at Satbhai, situated between the mouths of the river Brahmani and Mahanadi in Cuttack district of Orissa. They were captured from the sea at a distance of about one km from the shore. Since all the five species of marine turtles occurring in the

Indian Seas are protected under Schedule 1 of the Wild life (Protection) Act, 1982 (October, 1977 amendment) and Government of Orissa have been imposing the law stricltly within that state, the captured turtles were transported by boats to Digha and Banksalghat.

These turtles *(Lepidochelys olivacea)* weighed about 30-40 Kg each, the cost of each turtle being Rs.60/- to 80/- at Digha. Males and females were observed in the catches in equal proportions, ranging in Sizes from 620 to 750 mm (Carapace length) with the model size at 650-690 mm. They were mature and the females carried fully matured eggs.

It is estimated that a total of nearly one lakh numbers of turtles were landed at these two centres during 1981-82 season, by 15 units, each unit comprising of a motor launch and 6 country boats. The turtles are sent by trucks to Calcutta and Tata nagar for marketing.

Fig. 1. Turtles at the landing site at Digha

Such large scale distruction of mature turtles who come close to the shore for mating would probably lead to the depletion of their numbers in the coming years. It is earnestly hoped that West Bengal Government will take suitable conservation measures immediately, so that this valuable resource is not lost for ever.

Reported by S. S. Dan.

Another oceanographic research vessel for India

India has just taken delivery of an oceanographic research ship built by the Schlichting Shipyard in the Baltic Sea port of Luebeck - Travemuende and financed entirely (DM 80 Millions) by the Federal Republic of Germany.

The 100-metre-long and 16.39-metre- wide Sagar Kanya, which has a maximum speed of 14.25 knots, is one of the largest and most modern oceanographic research vessels in the world. Unlike other ships of its kind, it is capable of conducting experiments in a very wide area of oceanographic research.

The ship has a wide variety of basic outfits like laboratories, special equipment and working area to conduct research activities in geology, geophysics, meteorology, physical and chemical oceanography and marine biology.

Sagar Kanya will further expand the research activities carried out by the National Institute of Oceanography on board the indigenously-designed and built research ship Galveshani in collecting polymetallic nodules from the Indian Ocean seabed. The collection of the nodules containing manganese, nickel, cobalt and copper has assumed great significance especially after India qualified for the status of "pioneer investor" as defined by the recent U.N. Law of the Sea Conference.

The christening of the 1,300-tonne dwt vessel was done by Mrs. Zainub Khusro, wife of India's Ambassador to West Germany, Dr. A. M. Khusro.

Fungicide from shrimp shells

A scientist at Washington State University, Seattle has produced a natural fungicide out of shrimp shells. The shells of shrimps and other crustaceans are formed by a substance known as Chitin. It was found that chitosan, a compound derived from Chitin, effectively inhibits the growth of a broad range of fungi that attack plants. A solution made out of chitosan can be used directly as a fungicide suitable for spraying plant foliage or any other surface that might benefit from its antifungal properties.

Sea Secrets 25 (6): Nov.-Dec. 1981.

Marine mammals sleep in short naps

Marine mammals are found to sleep for shorter periods of time than some of the other animals and humans. Seals, sea lions, Walruses and sea otters are not completely restricted to water and will usually sleep on land. When far from land, they sleep at the water surface. Whales and dolphins typically sleep in short naps at the surface.

Since all marine mammals must breathe every few minutes, their sleep is adapted for regular surfacing and they rarely are completely still while

sleeping. Interestingly, the bottlenosed dolphin sleeps with only half of its brain at a time, while the other half remains awake. After an hour or so, these roles are reversed.

Most marine mammals do not sleep in regular daily patterns. A number of them have been observed continuously for several days without any noted sleeping behaviour. Humpback whales apparantly do not sleep at all during their long breeding migrations. At the same time collisions between ships and slumbering whales have also been reported.

Sea Secrets 26 (1): Jan.-Feb. 1982.

Hospital for marine mammals

The California Marine Mammal Center, located a few miles north of San Fransisco is actually a hospital for marine mammals. The staff and volunteers at the Center bestow medical supervision to mostly pinnipeds, namely seals and sea lions. The Center has been founded by Lloyd Smalley in 1975. Ever since, working 365 days of the year, often through day and night, hundreds of injured, orphaned or disoriented animals have been rescued, rehabilitated and released.

More than anything else, the Center works to get the animals back into their natural habitat, the sea in a healthy condition. Notification of an animal in distress sends the Center's rescue team into action. On location of the animal, usually exhausted youngsters stranded on the shore or injured animals, the team determines whether the animal is in real trouble. Then it is put on the rescue truck and transported to the Center, where proper medical treatment is administered, including proper nourishment and fluids in the case of dehydrated animals. A complete chart is kept on the progress of each animal with all medical treatment and husbandry care.

The average cost to care for an animal from the time of rescue to the time of release back into the sea is more than $300, which includes material costs such as transportation, food, medicine, cleaning supplies etc. but not salaries, cost of equipment and maintenance of facilities. Labour is provided by volunteer veterinarians, doctors, nurses, students and other interested individuals. There is also a scheme, the Adopt-A-Seal programme which permits anyone interested to contribute to the rehabilitation and release of a particular animal throughout its stay at the Center.

Sea Frontiers 28 (1): Jan.-Feb. 1982.

* * *

BOOKS

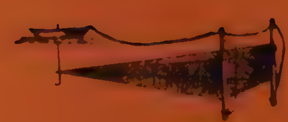
Commercial Fish Farming-With special reference to fish culture in Israel. By Balfour Hepher & Yoel Pruginin. John Wiley & Sons, New York pp, 261, 1981.

The book directs the reader systematically from the selection of sites for fish farms, to the planning, construction and management of ponds, through the fish reproduction techniques used both in ponds and hatcheries. Attention is also given to common hazards in fish ponds such as anoxia, diseases and off flavours. Extensive tables are provided to simplify the planning of production schedules.

The authors draw on their long experience in research and applied fish farming in Israel and many developing nations, to present the principles underlying the management methods and the best current practices in efficient commercial fish farms. While the emphasis of the book remains on the Israeli experience, its scope has been broadened to include more general aspects. In addition to discussing the economic aspects of fish farming, the biological and physical basis important for applying proper management techniques in different environmental and socio-economic conditions are clarified.

The book would be useful for fish farm managers, fish farm biologists, research scientists, technicians and fish breeders. It also would serve as a text for professors and students of aquaculture, who will find it particularly valuable for its emphasis on the theoretical basis of aquaculture.

Compiled and prepared by M. J. George, G. Subbaraju and S. K. Dharmaraja.
Published by Dr. M. J. George, Senior Scientist on behalf of the Director, Central Marine Fisheries Research Institute, Cochin-682 018. Phototypeset and printed at PAICO, Cochin 31.



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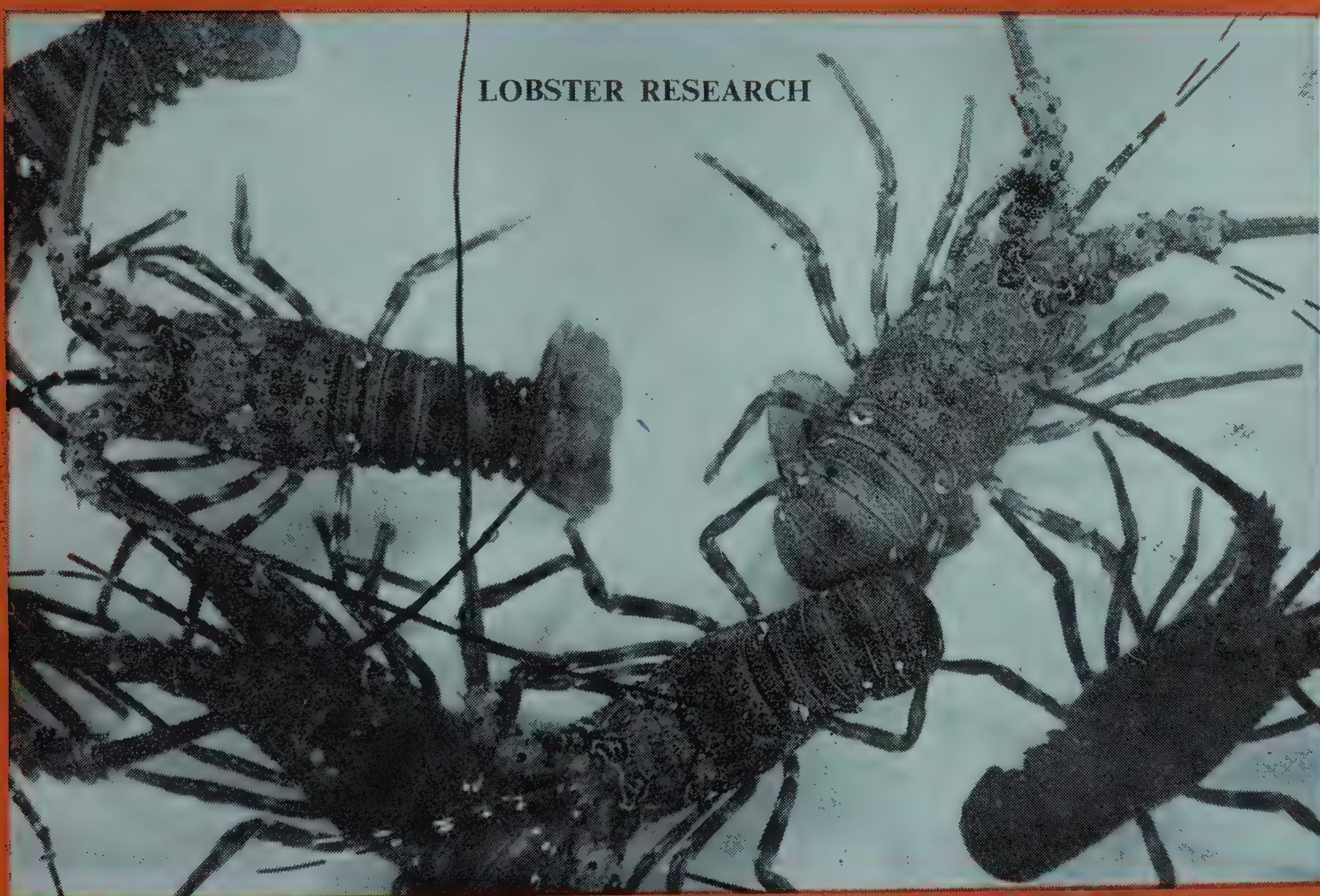

Technical and Extension Series

No. 43
OCTOBER, 1982

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE
COCHIN, INDIA

INDIAN COUNCIL OF AGRICULTURAL RESEARCH

THE MARINE FISHERIES INFORMATION SERVICE: Technical and Extension Series envisages the rapid dissemination of information on marine and brackish water fishery resources and allied data available with the Fishery Data Centre and the Research Divisions of the Institute, results of proven researches for transfer of technology to the fish farmers and industry and of other relevant information needed for Research and Development efforts in the marine fisheries sector.

Abbreviation—Mar. Fish. Infor. Serv. T & E Ser., No. 43: 1982.

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Cover photo: A group of spiny lobsters

MAJOR BREAKTHROUGH IN SPINY LOBSTER CULTURE

E.G.Silas, Director, Central Marine Fisheries Research Institute, Cochin-18.

Spiny lobsters form an important component of the crustacean resources of our marine fisheries. It is second in importance to prawns in terms of commercial value and has an export market. The Central Marine Fisheries Research Institute has been carrying out researches on spiny lobster resources along our coast, their fishery, production and biology based on the natural stocks. Due to its high export value, there has been heavy pressure on these coastal stocks. (Table)

Six species of spiny lobsers of commercial importance occur in Indian waters and these are:

Panulirus homarus (Linnaeus)
Panulirus polyphagus (Herbst)
Panulirus penicillatus (Oliver)
Panulirus ornatus (Fabricius)
Panulirus versicolor (Latreille)
Panulirus longipes (Milne-Edwards)

While the Institute is working on the rational exploitation of the lobster stocks, it has also started programmes for developing proper techniques for their culture. The major constraints encountered in lobster culture are:

1. Our inadequate knowledge of their reproductive physiology
2. Protracted complex life cycle with larval phase extending to several months and problems of maintaining the larvae.
3. Nutritional (feed) requirements of larvae and adults.
4. Slow growth of lobsters from puerulus stage to maturation and harvestable sizes.
5. Behaviour of lobsters.

In fact, even in areas such as water quality requirements, diseases, and management techniques for lobster culture, our knowledge is still meagre. In view of these inadequacies, the Institute has given priority for the following:

- Collection and maintenance of brood stock
- Controlled breeding
- Larval rearing
- Culture of baby lobsters (puerulus) to commercial size.

The programme also involves a multi-disciplinary approach including researches on nutrition, pathology, physiology, endocrinology and genetics.

One of the first tasks undertaken was the collection and the rearing of puerulii and metamorphosed baby lobsters of *P.homarus* to maturation and harvestable sizes. It was possible to collect from the inshore waters as well as from special puerulii collectors operated from rafts used for open sea mussel culture puerulii and young lobsters and rear them to marketable size of 200 gm weight under experimental conditions in a period of 18 months. The growth rates in such culture operations with clam and mussel meat as feed were almost identical with that studied for growth obtaining in the natural population of *P.homarus*. On an average, growth increment worked out to about 12 gm during each intermoult period, the moulting frequency being around once every 30 to 55 days. Further increment of weight is also characterised by such a slow trend of growth.

In connection with the work on growth and reproductive physiology and endocrinology of *P.homarus*, recourse to the wellknown and widely adopted technique of eye stalk ablation was resorted to. Such techniques are employed in studies on crustacean growth and reproduction in many parts of the world. The hormonal system in crustaceans involved in growth and reproduction is antagonistic and reproduction alternates with growth. There are the moulting hormone and the moult inhibiting hormone. Unlike in the case of vertebrates, particularly mammals, the endocrinology of crustaceans has been very little understood. The lobster culture programme in the Institute includes investigation on crustacean endocrinology in order to understand the hormonal regulation of growth and reproduction and to be able to manipulate these hormonal function, once they are clearly understood, to achieve higher growth rate and temporal control of reproduction.

In *P.homarus*,as in other crustaceans, the endocrine complex present in the eye stalk controls the secretion of hormone and hence the need to study this complex in detail. One of the wellknown methods in endocrinology is to block the system and to observe the results. As an experimental procedure, the eye stalk is electrically cauterised or ablated to block the hormonal system and study the effects on growth and reproduction.

Fig. 1. A group of normal spiny lobsters, *Panulirus homarus*.

Fig. 2. A group of eye ablated lobsters

Fig. 3. Close up view of a normal lobster to show the compound eyes

Fig. 4. An ablated lobster with antennule-like growth at the place of the ablated eyes (close up view)

Fig. 5. Control lobster after 90 days normal growth-49.7 gm to 71.3 gm.

Fig. 6. Eye ablated lobster after 90 days growth-49.7 gm to 184.3 gm.

Spiny lobster landings (with annual production estimates from three maritime states) and exports from India during 1978-1981

Year	Landings (in tonnes)				Export	
	All India	Maharashtra	Gujarat	Tamil Nadu	Quantity (in tonnes)	Value (1000 Rs.)
1978	1,307	607	339	249	691	45,668
1979	1,135	499	211	340	752	53,456
1980	679	225	204	90	501	27,889
1981	1,481	388	786	238	636	47,003

Fig. 7. An ablated lobster with antennule-like growth at the place of the ablated eye (Full view)

Fig. 8. An ablated lobster without the antennule-like growth.

The higher rate of growth observed in such eye stalk ablated lobsters is of great significance in regard to our understanding the hormonal action on moulting and growth. Since faster growth is a phenomena related to increase in production, it is of importance in culture production.

The results have been spectacular and fully justify consideration as a major breakthrough in making spiny lobster culture a viable proposition. My colleagues Shri E.V.Radhakrishnan and Shri M. Vijayakumaran who have been working under my guidance have in a series of experiments conducted on individual as well as groups of lobsters employing the eye ablation technique demonstrated that:

1. In a group of 10 early juvenile lobsters each weighing about 84.5 gm, when ablated and reared in experimental techniques for 165 days attained a mean weight of 432 gm as compared to the growth increment of only 57 gm for the control group.
2. In another trial involving 14 lobsters the average growth increment was 110.6 gm in 108 days, the corresponding growth for the control lobsters being 37.5 gm.
3. With repetitive trials with different number

Lobsters Are Human Too

IMAGINE a blinded animal growing big and strong and ... antennae in place of their blinded eyes ... that is what is done to lobsters ... menon is possible ... Scienti...

... gh mild of manner. were ... and publ...

Letters to the Editor

Do l... pain...

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NOVEM... TODAY

SCIENCE

LOBSTERS

A Giant Leap

IN A STARTLING discovery, marine scientists recently found that the Indian species of lobster, *Panulirus Homarus*, grow fastest when they have been blinded. The technique was developed at the Kovalam (Madras) ... ratory of ...

tank for 165 days. These lobsters grew to a mean weight of 432 grams. In the ... ablated group of lobsters ... and weight ...

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Do lobsters feel pain when blin...

MADRAS, Oct. 25.

Do lobsters which are blinded by s... tists feel pain? Is it not cruel to cli... eyestalks of these crustaceans?

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Dr. Guha ... the Centr... stitute ... is ...

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...y the concept of "pain" ... totally different from that ... objections should not ... the organisms ... portant sensory ... crustaceans ... ory mechani... "pain." ... ed by ... hat th... spon... nov...

tion of accelerated moulting ... tion) and precocious growt... eyestalks were re...

കണ്ണുകളഞ്ഞാൽ, കൊഞ്ചുവളരും

സ്റ്റാഫ് റിപ്പോർട്ടർ

"How do you know"

Sir, — In defence of blinding lobsters, (THE HINDU, October 26), Dr. Guha Prasad has observed that "the question of pain or suffering is a projection of our own mind" and "the concept of pain in lower animals is totally different from that in human beings".

I am reminded of the following conversation in an old movie called "I want to live" between Miss Barbara Graham, the condemned prisoner in the gas chamber and her executioner:

Executioner: "Miss Graham, when I pull the lever the cyanide pellets will sink into the acid and the fumes will engulf the chamber. Take a deep breath, it will be painless".

Graham: "How do you know?"

S. Rajagopalan

HINDU

of lobsters varying from 4 to 18, the growth increase in the eye stalk ablated lobsters recorded was between 1.45 and 2.5 gm/day, which in the controls was hardly 0.35 gm/day, all lobsters being fed *ad libitum* with clam meat.

4. In one experiment, a lobster with an initial weight of 254 gm attained 402 gm after a single moult in 31 days – a weight increase of 148 gm after a moult! These figures appear incredible as compared to hardly 12 gm increment in weight recorded in the inter--moult period of about one month in the controls as well as observed in the natural population.

These findings are remarkable since eye ablation technique in the American and Australian spiny lobsters *P.argus* and *P.cyngus* respectively did not yield results. This also definitely shows that culture of lobster from puerulus or early juveniles to a marketable size of 180 to 200 gm is possible in about 5 to 6 months and an almost doubling of weight is possible in another 2 to 3 months – in other words a 400 gm lobster in about 9 months!

From the time that the results of these experiments on spiny lobster growth adopting the eye ablation technique was announced, there has been a spate of letters in some of our national dailies questioning the ethics of such experiments with animals as this is considered as being against the tradition of our country (ref: p.4). In scientific research, experimentation with animals is inevitable. Such researches on other crustaceans have been in vogue for ages all over the world. Here the mandate has been to find out whether mariculture of spiny lobsters is a feasible proposition or not. Complacency due to the negative results obtained by scientists in the USA and Australia would have put the clock back several years. The success with eye ablation technique has now given us a clue as well as a lead to enhance our indepth studies on the endocrinological function of growth and maturation to map the endocrine organ, identify the hormones and understand their functions. The next step could be the acceleration or inhibition of growth/maturation as may be desired in the different phases of culture, through hormonal treatment and not consider eye ablation as the ultimate technology for obtaining higher production.

These researches no doubt open up the great possibilities of developing genetically faster growing strains for producing "Giant" lobsters and more than all make *P.homarus* a very good candidate species for culture. I would also take this opportunity to announce that my colleagues Shri E.V.RadhaKrishnan and Shri M.Vijayakumaran have also met with success in experiments carried out on 2 other species, *P.ornatus* and *P.polyphagus*. The lobster culture programme in the Institute is being accelerated to answer many of the problems that have come up in the course of the work undertaken during the last 2 years.

UNPRECEDENTED GROWTH INDUCED IN SPINY LOBSTERS

E.V.Radhakrishnan and M.Vijayakumaran

Introduction

With the ever increasing demand, the lobster fishing grounds all over the world are being heavily exploited and this is also true in Indian lobster fishery. Attempts for growing lobsters in captivity in order to augment the production have met with only partial success. Apart from other problems their slow growth rate is one of the main constraints. Investigations have been carried out at the Field Laboratory of the Central Marine Fisheries Research Institute at Kovalam, Madras since 1976 to rear the spiny lobster *Panulirus homarus*, which contributes to a major portion of the lobster fishery in southern parts of India. Early juveniles of this species have been consistently reared in the laboratory to marketable sizes in a period of sixteen to eighteen months. However, it was felt that it may not be economically feasible to carryout large scale culture of lobsters unless the rearing period is brought down considerably. The only way to accomplish this is by accelerating the growth rate of lobsters and this has been the major concern of the CMFRI Laboratory at Kovalam, resulting in several experimental studies.

It has been well established that the X-organ sinus gland complex in the eyestalk of crustaceans plays a major role in the control of moulting and growth in them. Experiments in ablation of eyestalks and thereby removal of the gland complex was not found to be useful in the acceleration of moulting in *P. cygnus* in Australia and *P. argus* in America, leading to the conclusion that Moult Inhibiting Factor (MIH factor) may not be present in the eyestalk of palinurid lobsters. However, encouraging results have been obtained for the first time in accelerating moulting frequency and weight gain in the spiny lobster *P. homarus* consequent to the present experiments in removal of eyestalks.

Early juveniles, maturing and mature *P. homarus* ranging from 20 to 250 g in body weight were used in this study. The technique used was bilateral removal of eyestalks by ligation. Lobsters were reared in groups and equal number of males and females were used in all the treatments. Salinity of the seawater used varied between 32 and 35‰ and the water temperature ranged from 22 to 33.8 °C. In the experiments the lobsters were fed *ad libitum* on the clam *Meretrix casta* twice daily. In one of the experiments mussel meat and chopped fishes were given once daily initially and clam meat twice daily later.

Moulting frequency

The results prove that eyestalk removal accelerated frequency of moulting in *P. homarus*, indicating the presence of an MIH factor in the eyestalk. Whereas the control lobsters moulted 4 times in 140 days reaching 70 g, the ablated lobsters moulted 7 times to reach the marketable size of 200 g in the same period. Intermoult period increased with the size in both ablated and control lobsters, but the increase in ablated ones was considerably lower than that of the control.

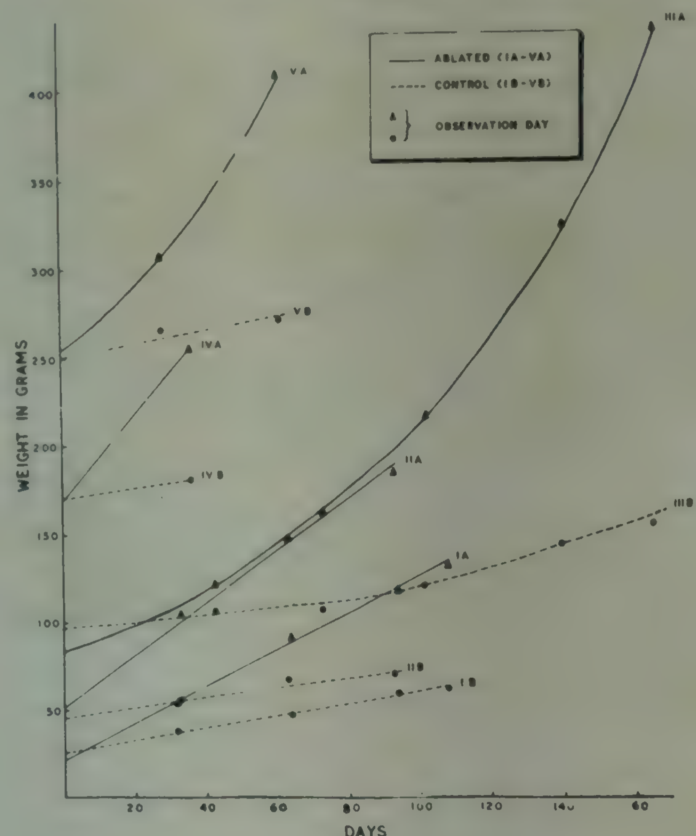

Fig. 1. Increase in weight in eye ablated and control spiny lobsters *P.homarus* in different experiments.

Weight gain

The weight gain in ablated and control lobsters from experiments I to V is shown in Figure 1. Growth of lobsters is a manifestation of moul-

Table 1. *Growth of ablated and control lobsters Panulirus homarus*

Expt. No.		Description	No. of lobsters	INITIAL		FINAL		Total No. of days	Increase in weight/day (g) (Average)	% increase/day
				CL (mm)	Wt. (g)	CL (mm)	Wt. (g)			
I	A	ABLATED	14	27.0	20.4	53.1	131.0	108	1.02	5.0
	B	CONTROL	14	28.7	24.8	39.7	62.3		0.35	1.4
II	A	ABLATED	6 × 3 (18 Nos)	36.5	49.7	59.7	184.3	93	1.45	2.9
	B	CONTROL	6 × 2 (12 Nos)	35.8	46.8	41.9	71.3		0.26	0.55
III	A	ABLATED	10	44.7	84.5	77.4	432.0	165	2.1	2.48
	B	CONTROL	10	47.3	98.6	56.2	155.7		0.35	0.35
IV	A	ABLATED	4	56.2	169.0	65.3	255.0	36	2.38	1.46
	B	CONTROL	4	58.2	169.2	59.2	181.0		0.33	0.19
V	A	ABLATED	6	66.1	256.5	77.8	408.0	61	2.5	0.97
	B	CONTROL	6	66.0	250.3	67.4	272.5		0.36	0.14
VI	A	ABLATED	5	41.2	69.4	53.0	141.0	63	1.14	1.64
	B	CONTROL	5	39.9	66.0	44.2	83.4		0.28	0.42

Fig. 2. Growth difference in eye ablated (right) and control (left) spiny lobsters.

ting and size and weight increase at moult. Eyestalk ablation in *P. homarus* accelerated both these factors and enhanced growth rate obtained is the cumulative effect of these two. Three to sevenfold increase in weight was obtained in ablated lobsters compared to the control (Fig. 2). Weight increase per day is proportional to the size of the lobsters. Ablated juveniles recorded an average increase of 1.02 g/day while the increase was only 0.35 g/day in the control. Weight increase per day gradually increased with size and the maximum of 2.5 g/day was obtained in maturing and mature lobsters (Table 1). Eventhough relative increase in growth, expressed in terms of percentage weight gain per day, was more in early juveniles, absolute increase in bodyweight was higher in bigger lobsters. Maximum weight gain of 4.6 g/day was obtained in an ablated mature lobster weighing 256 g.

Food conversion

Accelerated growth is achieved by increased food consumption and assimilation and by better conversion efficiency. The experiments show that in *P.homarus*, at *ad libitum* level of feeding, food consumption of ablated lobsters was twice that of the control animals, recording two to three fold increase in food conversion efficiency. Even when equal quantities of food wire given to both the groups in Expt.VI the ablated ones recorded four fold increase in weight compared to control. This would indicate that increased food intake in ablated individuals only may be supplementing the individuals only may be supplementing the accelerated growth rate caused mainly by hormonal imbalance.

Tail weight

The proportion of tail weight to body weight of ablated and control lobsters weighing 200 g and above shows that there is no significant difference in this relationship between the experimental and control animals. The percentage dry matter in the flesh also showed similar trend indicating that ablation do not alter this relationship.

General remarks

Apparantly there is a Moult Inhibiting Hormone Factor in the eyestalk of spiny lobsters, which on removal accelerate the growth significantly. Further experiments are in progress to

map out the gland so that manipulation of the hormone produced by the gland may accelerate the growth rate without impairing the vision of the lobsters. This basic discovery opens up further avenues for advanced research in lobster endocrinology.

From the present results it is clear that it would be possible to grow marketable size lobsters from juvenile stage in 5 to 6 months and to double the size in another 3 or 4 months. Such phenomenal growth would throw open great possibilities of developing genetically fast growing strains of lobsters and more than all make *P. homarus* a very suitable candidate species for culture.

We are thankful to Dr. E. G. Silas, Director, CMFRI for constant encouragement and guidance.

SYNOPSIS OF MARINE PRAWN FISHERY OF INDIA-1981*

Total production

The total marine prawn production during the year 1981 was estimated at 1,44,969 tonnes against 1,70,737 tonnes in 1980 (Table 1), showing a decrease of 25, 768 t (15.1%). A glance at the marine prawn production of the country over the past few years indicates that the trend of decrease from the maximum in 1975 is maintained over these years and this year the comparative reduction is considerably high and this is mostly brought about by reduced catches in Kerala State, especially in a single centre, ie. Neendakara and that too of a single species of penaeid prawn.

Taking into account the production of the penaeid prawns and nonpenaeid prawns separately the decrease in landings in 1981 is noticed only in penaeid prawns, while nonpenaeid prawns showed an increase from that of 1980 (Table 2). During 1981 the penaeid prawn catch recorded a reduction of 28,498 t (25.4%) and the nonpenaeids an increase of 2,730 t (4.7%). The decrease in penaeid prawn catch is mostly due to the steep decline in a single species catch occurring in Kerala State, the catch declining from 52,633 t in 1980 to 22,268 t in 1981.

Compared to last year, when the maximum production was in the month of July, the maximum productive months in 1981 were April and May, in which months maximum quantities of prawns were landed in Maharashtra (Table 3). The failure of the monsoon fishery of Neendakara in Kerala state this year is the main reason for July going out of the picture, as the maximum productive months for prawns September, June and August were the months in which minimum quantities of prawns were landed. In Kerala State, of course the maximum productive month is July, but the decline in the total quantity of prawns landed in that month at Neendakara to less than one third of the catch of last year has made the month less conspicuous in production at all India level. However for taking the penaeid prawns alone July is the month of maximum production and September and June least productive. For nonpenaeid prawns April-May is the period of maximum production, the major portion coming from the state of Maharashtra. June to September is the least productive months for nonpenaeid prawns.

As usual the statewise production this year also shows the maximum in Maharashtra, being 51.4% showing 10% more than last year. On the contrary the percentage contribution of Kerala state registered nearly 16% decrease, giving only 15.5% of the total production (Table 1) against 31.8% of last year. The statewise and monthwise landings of penaeid and nonpenaeid prawns (Table 4 and 5) indicate that penaeid prawns contribute to the major portion of the fishery in Kerala, Tamil Nadu, Pondicherry and Orissa. Almost the entire fishery of Goa, Andamans and Karnataka is contributed by penaeid prawns. In Gujarat about two thirds of the fishery is contributed by penaeids while in Andhra Pradesh penaeid prawns formed

* Prepared by Crustacean Fisheries Resources team. Compilation: M.J.George, C.Suseelan M.M.Thomas V.S.Kakati, and C.Nalini.

Table 1. *Statewise prawn landings and percentage contributions during 1981 and 1980*

Maritime States	Prawn landings in tonnes		Percentage	
	1981	1980	1981	1980
Gujarat	15,727	18,590	10.8	10.8
Maharashtra	74,571	70,742	51.4	41.4
Goa	2,237	1,853	1.6	1.0
Karnataka	4,126	3,226	2.9	1.8
Kerala	22,428	54,375	15.5	31.8
Tamil Nadu	14,252	10,028	9.8	5.8
Pondicherry	389	527	0.3	0.3
Andhra Pradesh	8,335	10,006	5.8	5.8
Orissa	1,383	1,104	0.9	0.6
West Bengal	1,495	200	1.0	0.1
Andamans	26	54	–	–
Larger trawlers	*	32	–	–
All India Total	1,44,969	1,70,737	100	100

*144 tonnes included with the catch of Andhra Pradesh

Table 6. *Species wise break up of prawn landings and percentages during 1981*

Species	All India landings in tonnes	percentage
Solenocera crassicornis	8,084	5.6
Penaeus indicus	7,537	5.2
P.merguiensis	1,096	0.8
P.monodon	941	0.6
P.semisulcatus	7,898	5.4
Metapenaeopsis stridulans	506	0.3
Metapenaeus dobsoni	10,059	6.9
M.affinis	5,025	3.5
M.monoceros	7,073	4.9
M.brevicornis	907	0.6
M.kutchensis	857	0.6
Parapenaeopsis stylifera	29,109	20.1
P.hardwickii	2,123	1.5
Acetes indicus	38,430	26.5
Nematopalaemon tenuipes	19,698	13.6
Exopalaemon styliferus	859	0.6
Exhippolysmata ensirostris	2,309	1.6
Other species	2,458	1.7
Total	1,44,969	100.0

Table 2. *Statewise penaeid and non-penaeid prawn landings and their percentage for 1981 and 1980*

Maritime States	Landings in tonnes and percentage							
	1981				1980			
	Penaeid		Non-penaeid		Penaeid		Non-penaeid	
	Catch	%	Catch	%	Catch	%	Catch	%
Gujarat	10,985	13.1	4,742	7.8	14,481	12.9	4,109	7.0
Maharashtra	21,717	26.0	52,854	86.0	23,433	20.9	47,309	80.5
Goa	2,237	2.7	–	–	1,853	1.6	–	–
Karnataka	4,122	4.9	4	–	3,098	2.7	128	0.2
Kerala	22,268	26.7	160	0.3	52,633	46.9	1,742	2.9
Tamil Nadu	13,548	16.2	704	1.1	9,082	8.1	946	1.6
Pondicherry	336	0.4	53	0.1	485	0.4	42	–
Andhra Pradesh	6,728	8.1	1,607	2.6	5,660	5.0	4,346	7.4
Orissa	1,328	1.6	55	0.1	1,074	0.9	30	–
West Bengal	244	0.3	1,251	2.0	152	0.1	48	–
Andamans	26	–	–	–	54	–	–	–
Larger trawlers	*	–	–	–	32	–	–	–
All India total	83,539	100	61,430	100	1,12,037	100	58,700	100

* 144 tonnes included with the catch of Andhra Pradesh.

Table 3. *Monthly prawn landings in different maritime states during 1981*

Maritime states	Prawn catch in tonnes													Total for 1981
	Jan.	Feb.	March	April	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Larger trawlers	
Gujarat	1,635	428	1,394	1,183	1,063	37	47	210	580	3,841	3,530	1,779	–	15,727
Maharashtra	6,805	7,798	7,056	14,254	17,199	1,228	305	931	2,057	6,480	4,761	5,688	–	74,571
Goa	375	157	414	153	283	205	2	210	6	6	4	422	–	2,237
Karnataka	546	462	297	700	524	10	451	61	242	6	194	633	–	4,126
Kerala	1,415	852	1,060	836	1,662	1,765	7,621	4,732	455	395	969	666	–	22,428
Tamil Nadu	917	730	468	1,144	796	1,649	3,773	1,249	538	802	1,123	1,063	–	14,252
Pondicherry	84	25	23	38	37	54	34	17	9	2	9	57	–	389
Andhra Pradesh	713	1,469	219	605	274	250	945	1,178	806	699	622	411	144	8,335
Orissa	122	114	20	64	103	25	29	51	72	213	165	405	–	1,383
West Bengal	772	–	–	2	2	–	6	2	–	1	568	142	–	1,495
Andamans	–	–	5	–	–	4	–	–	7	–	–	10	–	26
All India Total	13,384	12,035	10,956	18,979	21,943	5,227	13,213	8,641	4,772	12,454	11,945	11,276	144	1,44,969
Monthwise percentage	9.2	8.3	7.6	13.1	15.1	3.6	9.1	6.0	3.3	8.6	8.2	7.8	0.1	

Table 4. *Penaeid prawn landings in different maritime states during 1981*

Maritime States	Prawn catch in tonnes													Total for 1981
	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Larger trawlers	
Gujarat	1,500	345	403	398	295	19	3	162	486	2,822	3,048	1,504	–	10,985
Maharashtra	2,225	1,481	2,347	3,050	1,644	486	151	514	1,390	2,960	2,814	2,655	–	21,717
Goa	375	157	414	153	283	205	2	210	6	6	4	422	–	2,237
Karnataka	546	462	297	700	524	10	451	61	242	6	190	633	–	4,122
Kerala	1,414	829	1,026	811	1,650	1,755	7,591	4,732	430	395	969	666	–	22,268
Tamil Nadu	908	719	452	1,126	783	1,410	3,531	1,217	519	764	1,071	1,048	–	13,548
Pondicherry	48	17	22	38	37	49	34	17	9	2	9	54	–	336
Andhra Pradesh	652	1,461	205	318	271	214	639	459	772	678	538	377	144	6,728
Orissa	122	114	20	64	103	25	29	49	72	174	151	405	–	1,328
West Bengal	–	–	–	–	–	–	4	2	–	1	212	25	–	244
Andamans	–	–	5	–	–	4	–	–	7	–	–	10	–	26
All India total	7,790	5,585	5,191	6,658	5,590	4,177	12,435	7,423	3,933	7,808	9,006	7,799	144	83,539
Monthwise percentage	9.3	6.7	6.2	7.9	6.7	5.0	14.9	8.9	4.7	9.3	10.9	9.3	0.2	

Table 5. *Non-penaeid prawn landings in different maritime states during 1981*

Maritime States	Jan.	Feb.	March	April	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Total for 1981
	Prawn catch in tonnes												
Gujarat	135	83	991	785	768	18	44	48	94	1,019	482	275	4,742
Maharashtra	4,580	6,317	4,709	11,204	15,555	742	154	417	667	3,529	1,947	3,033	52,854
Goa	-	-	-	-	-	-	-	-	-	-	-	-	-
Karnataka	-	-	-	-	-	-	-	-	-	-	4	-	4
Kerala	1	23	34	25	12	10	30	-	25	-	-	-	160
Tamil Nadu	9	11	16	18	13	239	242	32	19	38	52	15	704
Pondicherry	36	8	1	-	-	5	-	-	-	-	-	3	53
Andhra Pradesh	61	8	14	287	3	36	306	719	34	21	84	34	1,607
Orissa	-	-	-	-	-	-	-	2	-	39	14	-	55
West Bengal	772	-	-	2	2	-	2	-	-	-	356	117	1,251
Andamans	-	-	-	-	-	-	-	-	-	-	-	-	-
All India Total	5,594	6,450	5,765	12,321	16,353	1,050	778	1,218	839	4,646	2,939	3,477	61,430
Monthwise percentage	9.1	10.5	9.4	20.1	26.6	1.7	1.3	1.9	1.4	7.6	4.8	5.6	

Table 7. *Annual percentage distribution of important species in the prawn landings at different centres during 1981*

Centres	PENAEIDS												
	S.crassicornis	*P.indicus*	*P.merguiensis*	*P.monodon*	*P.semisulcatus*	*M.stridulans*	*M.dobsoni*	*M.affinis*	*M.monoceros*	*M.brevicornis*	*M.kutchensis*	*P.stylifera*	*P.hardwickii*
Veraval	13.9	-	-	-	5.8	-	-	7.5	5.8	-	7.8	41.7	12.4
Bombay	28.7	-	-	-	-	-	-	11.9	10.6	2.8	-	39.1	3.5
Karwar	-	0.2	0.8	0.2	-	-	20.7	9.1	39.1	-	-	29.5	-
Malpe	-	3.7	-	0.5	-	-	32.3	3.7	12.6	-	-	47.2	-
Mangalore	-	3.6	-	0.7	-	-	45.5	1.4	6.8	-	-	42.0	-
Calicut	-	5.7	-	-	-	-	56.3	-	1.4	-	-	36.7	-
Cochin	-	10.9	-	0.2	-	-	37.7	1.1	0.3	-	-	49.2	-
Neendakara	-	9.2	-	0.1	0.1	-	3.5	2.1	1.4	-	-	83.1	-
Tuticorin	-	44.2	-	-	55.0	-	0.4	-	-	-	-	-	-
Mandapam	-	2.3	-	-	81.3	-	-	9.3	-	-	-	-	-
Madras	-	26.7	-	8.6	20.2	-	20.7	-	23.8	-	-	-	-
Kakinada	-	12.3	3.7	8.6	-	-	16.0	8.1	14.5	10.7	-	6.3	-
Waltair	11.7	12.4	-	5.3	0.7	18.3	6.8	-	41.9	-	-	-	-
Puri	-	49.7	35.8	2.8	-	-	-	11.7	-				-

	NON-PENAEIDS			
	A.indicus	*N.tenuipes*	*E.styliferus*	*E.ensirostris*
Veraval	46.0	32.8	-	21.2
Bombay	66.0	32.5	-	1.5
Kakinada	30.6	21.2	20.4	11.5

three fourths of the total prawn fishery. In Maharashtra only more than two thirds of the fishery is constituted by nonpenaeid prawns, out of which the maximum quantities were landed in the months of April and May.

In the overall species composition in the prawn landings (Table 6) as in 1979 *Acetes indicus* ranked first (26.5%), relegating *Parapenaeopsis stylifera* (20.1%), which came first in 1980, to the second position. This was mainly due to the poor landings of *P.stylifera* in this year during the monsoon fishery at Neendakara in Kerala State. The other important species in the order of their abundance were *Nematopalaemon tenuipes*, *Metapenaeus dobsoni*, *Solenocera crassicornis*, *Penaeus semisulcatus*, *Penaeus indicus*, *Metapenaeus monoceros* and *M.affinis*, which collectively accounted for 45.1% of the total production. Noticeable changes evident from previous year's data in the case of the representation of these species are the third position taken by the nonpenaeid prawn *N.tenuipes* relegating *M.dobsoni* to fourth postion and increased representation of *S.crassicornis* and *P. semisulcatus* occupying fifth and sixth positions respectively. The dominant species *A.indicus* was mostly harvested from Maharashtra, Gujarat and Andhra Pradesh. The annual percentage distribution of important species at different observation centres during 1981 is given in table 7.

Gearwise production

Shrimp trawls operated by various sizes of boats formed the single major gear employed in the exploitation of prawns as in the previous years.

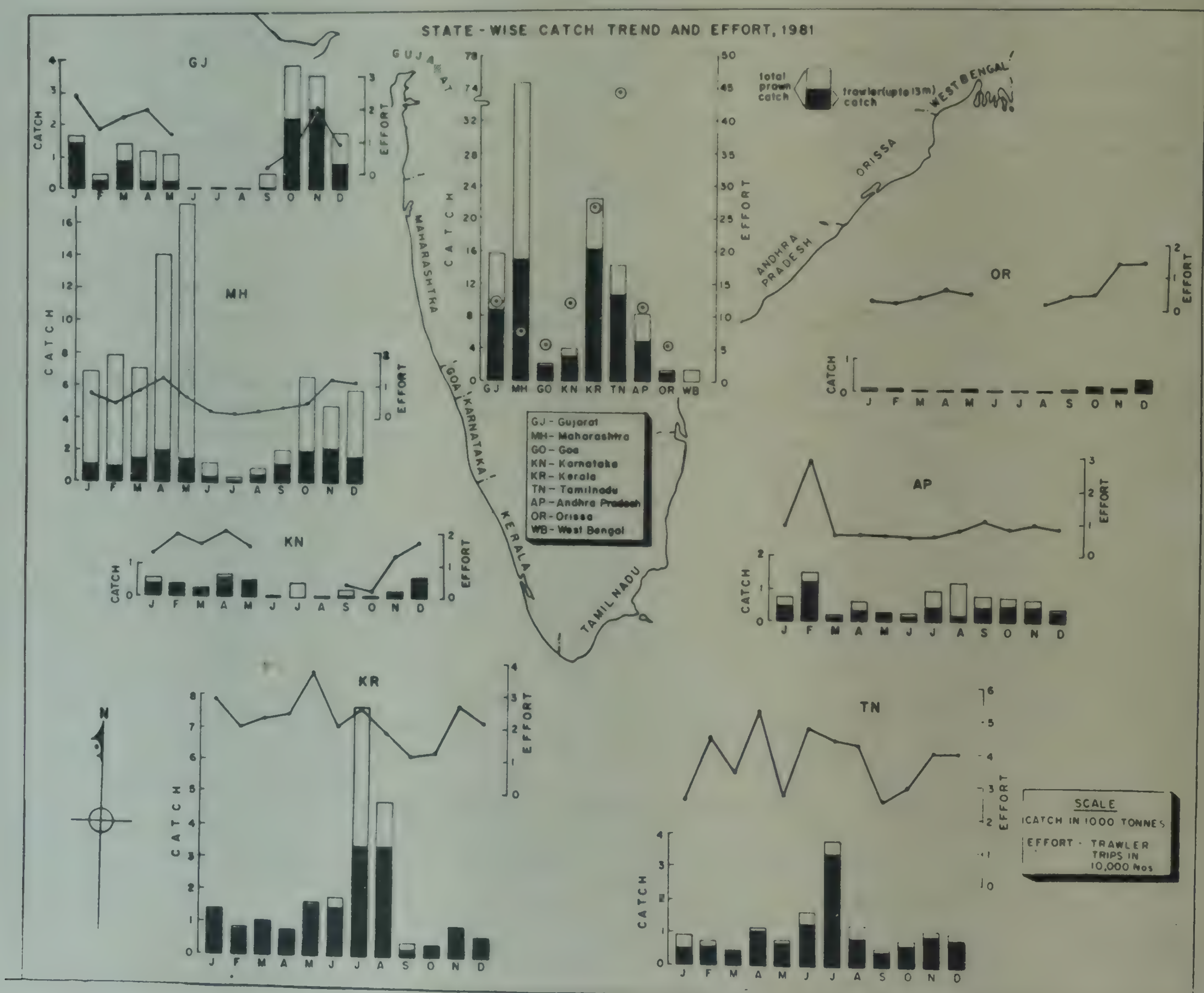

Fig. 1. Prawn landings by commercial shrimp trawlers in relation to the total prawn catch and the fishing effort during 1981.

The overall fishing input by this gear showed improvement to the extent of 6% over that of last year. While the fishing was more active in most of the maritime states this year, it decreased considerably in Maharashtra, Kerala and Orissa.

In spite of the general increase in fishing effort, the production of prawns by trawlers declined to 63,689 t from 87,956 t of the previous year showing a reduction rate of 27.6%. This was mainly due to the lower landings recorded along the coasts of Kerala. While in most of the other states the increase in trawler landings was only marginal, Tamil Nadu and Orissa registered remarkably good catches with an increase to the tune of 82% in the former and 47% in the latter state over the production of the previous year. Out of the total estimated prawn catch of 1,44,969 t from the marine sector the trawler landings accounted for 44% as against 51.5% of last year. The rest of the catch was mainly contributed by fixed bag nets in Gujarat, Maharashtra and West Bengal and seines, gill nets and other indigenous gears in the other states. The statewise percentage contributions of prawn landings by shrimp trawlers for this year as well as the previous year (in parenthesis) were: Kerala-25.6 (52.4), Maharashtra-23.4 (17.1), Tamil Nadu-18.3 (7.3), Gujarat-13.8 (11.7), Andhra Pradesh-8.1 (4.4), Karnataka-5.2 (3.4), Goa-3.2 (2.0), Orissa-1.9 (1.0) and Pondicherry-0.5 (0.4). Penaeid prawns accounted for the bulk of these catches in all the states, forming 92-100%.

The annual as well as seasonal production trends of the commercial trawl fishery of different maritime states in relation to the effort and total prawn landings are depicted in Fig. 1. In the annual prawn landings of individual states trawlers contributed to the major share in Goa (90.5%), Orissa (89.7%), Tamil Nadu (82.0%), Karnataka (78.4%), Pondicherry (76.3%), Kerala (72.7%), Andhra Pradesh (60.5%) and Gujarat (56.0%). In Maharashtra its contribution was only 20% which was slightly less than that of previous year (21.3%). The peak landings were recorded during February in Andhra Pradesh, April in Karnataka, July in Tamil Nadu, July and August in Kerala, November in Gujarat and Maharashtra and December in Goa, Pondicherry and Orissa.

The striking change noticed in this year in the trawl fishery of the country was that of Kerala where a severe decline in the production of penaeid prawns was observed. This was mainly due to the failure of the monsoon fishery for 'Karikkadi' *(Parapenaeopsis stylifera)* at Sakthiku langara--Neendakara area. The sudden increase in prawn catch by indigenous gears in this state was brought about by the unusual landings of 'Poovalan chemmeen' *(Metapenaeus dobsoni)* in boat seines during the monsoon months (July & August) at Cannanore and nearby centres.

Veraval (Fig. 2)

Prawn fishing at Veraval and nearby centres was fairly active with an off-season in June-August for trawlers and July-August for 'Dol' nets due to monsoon. The prawn production, however, was much less than that of the previous year. At Veraval, the penaeid prawn landings of shrimp trawlers amounted to only 1,144 t at an annual catch rate of 2.5 kg/hr as against 1,590 t at the rate of 4.4 kg/hr of trawling during 1980. The maximum catch as well as CPUE were recorded during November. As in the previous year, *Parapenaeopsis stylifera* was the dominant species (41.7%) followed by *Solenocera crassicornis* (13.9%), *P.hardwickii* (12.4%), *Metapenaeus kutchensis* (7.8%), *M.affinis* (7.5%) and *M.monoceros* (5.8%) among the regular species. Significant quantities of other penaeid prawns were also landed occasionally, of which *Penaeus penicillatus* and *P.semisulcatus* were important from the point of export industry. The unusually heavy landings of *P.semisulcatus* during October (64.7 t) to the extent of contributing nearly 63% of the penaeid prawn catches of the trawlers was a significant feature noticed in the prawn fishery of this centre during this year. Normally this species is not caught in commercial quantities along this coast. The new occurrence of the species was spread over the shallow as well as deeper areas upto about 80 m depth. Although a wide range of size groups of this species was represented, males of 141-160 mm and female of 141-195 mm, which were sold at Rs. 40-55 per kg, formed the bulk of the catches. Majority of the females were in 'spent' or 'spentrecovering' stages of ovarian maturity and indicated the possibility of completion of their spawning in the offshore waters of this coast. It is interesting to note in this context that in recent years the occurrence of *P.semisulcatus* in the marine and estuarine environments has been steadily increasing along some other areas also.

There was no significant change in the size distribution of the major species of prawns landed at this centre in comparison with that of the previous year. The important size groups that supported the fishery were 73-78 mm for *P.stylifera*, 58-63 mm and 93-123 mm for *P.hardwickii*,

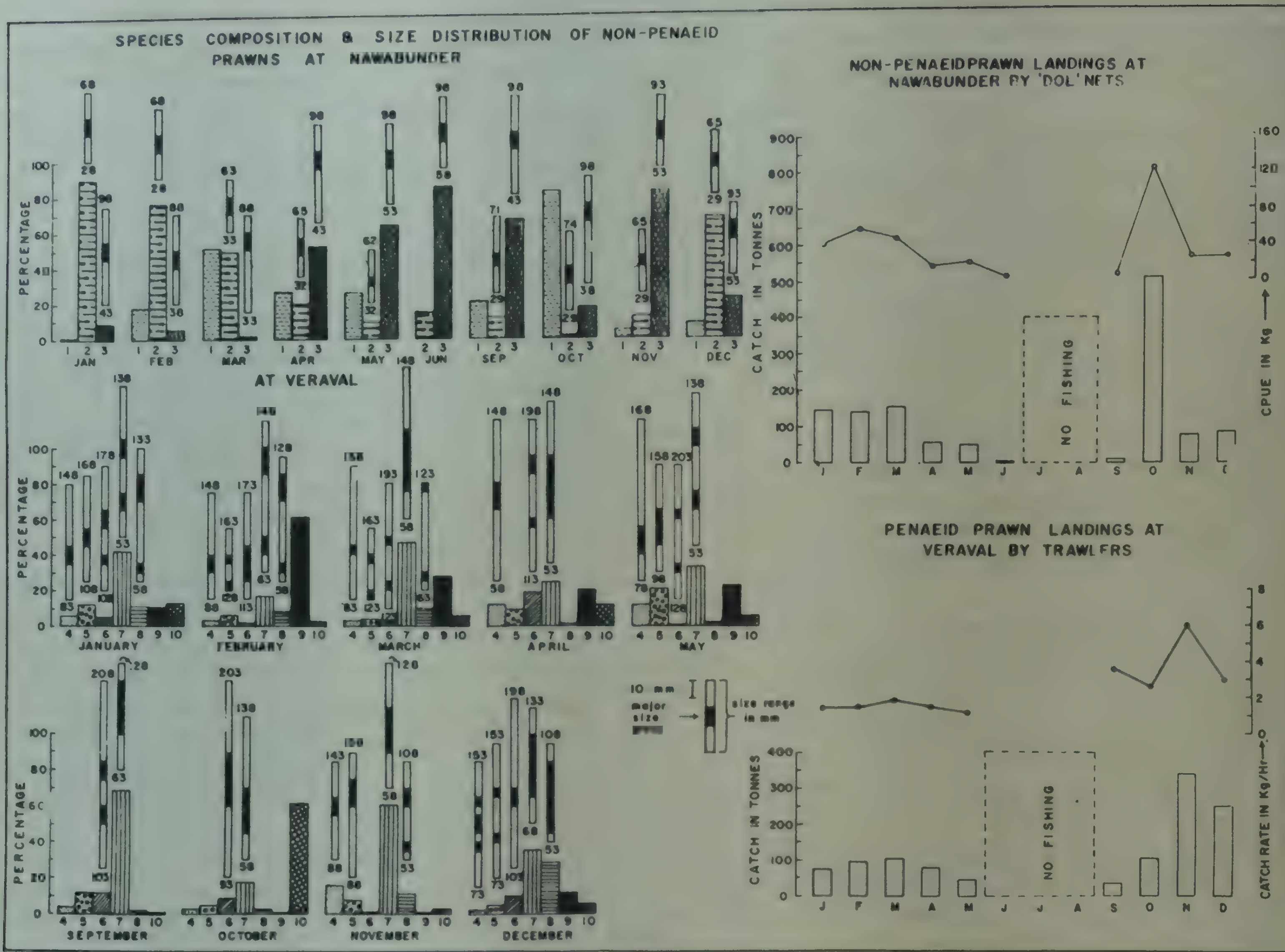

Fig. 2. Catch trend, species composition and size distribution of important species of prawns at Veraval during 1981. *1. A.indicus, 2. N.tenuipes, 3. E.ensirostris, 4. M.kutchensis, 5. M.affinis, 6. M.monoceros, 7. P.stylifera, 8. P.hardwickii, 9. S.crassicornis,* 10. Other penaeid prawns.

113–143 mm for *M.affinis* and 123 –163 mm for *M.monoceros.* Peak spawning activities for most of these species were observed during January to May as in the previous year (Fig. 10).

At Nawabunder the non-penaeid prawn landings by 'Dol' nets decreased to 1,227 t from 1,971 t of last year with a corresponding reduction in CPUE from 77.55 kg to 44.85 kg. *Acetes indicus* (46.0%), *Nematopalaemon tenuipes* (32.8%) and *Exhippolysmata ensirostris* (21.2%) constituted the fishery. Peak landing was recorded in October.

Bombay (Fig. 3)

At New Ferry Wharf an estimated catch of 6,011 t of penaeid prawns was landed by trawlers which was 420 t less than in the previous year. The catch rate worked out to 313.2 kg/unit as against 319.5 kg of last year. Peak landings were recorded during March–April and September–November, with meagre fishing activities during the monsoon period June–August. The comparatively lesser production of prawns this year was mainly due to the reduced landings during the postmonsoon season. The premonsoon fishery, however, was relatively of higher magnitude. As usual, *P.stylifera* dominated in the fishery contributing to 39.1% of the annual landings, which was followed by *S.crassicornis* (28.7%), *M.affinis* (11.9%), *M.monoceros* (10.6%) and others. The catch of *S.crassicornis* was exceptionally high during February to April and so also was *P.stylifera* during October and November. Peak landing for *M.affinis* was recorded during September–October. The principal size groups of the important species were 71–125 mm for *P.stylifera*, 56–105 mm for *S.crassicornis* and 116–145 mm for *M.affinis*. Percentage of mature females in the catch was very low, being 1.7–9.5 only for *P.stylifera* and 1.0–6.1 for *M.affinis*. Peak breeding period was April–May for the former species and November for the latter (Fig. 10).

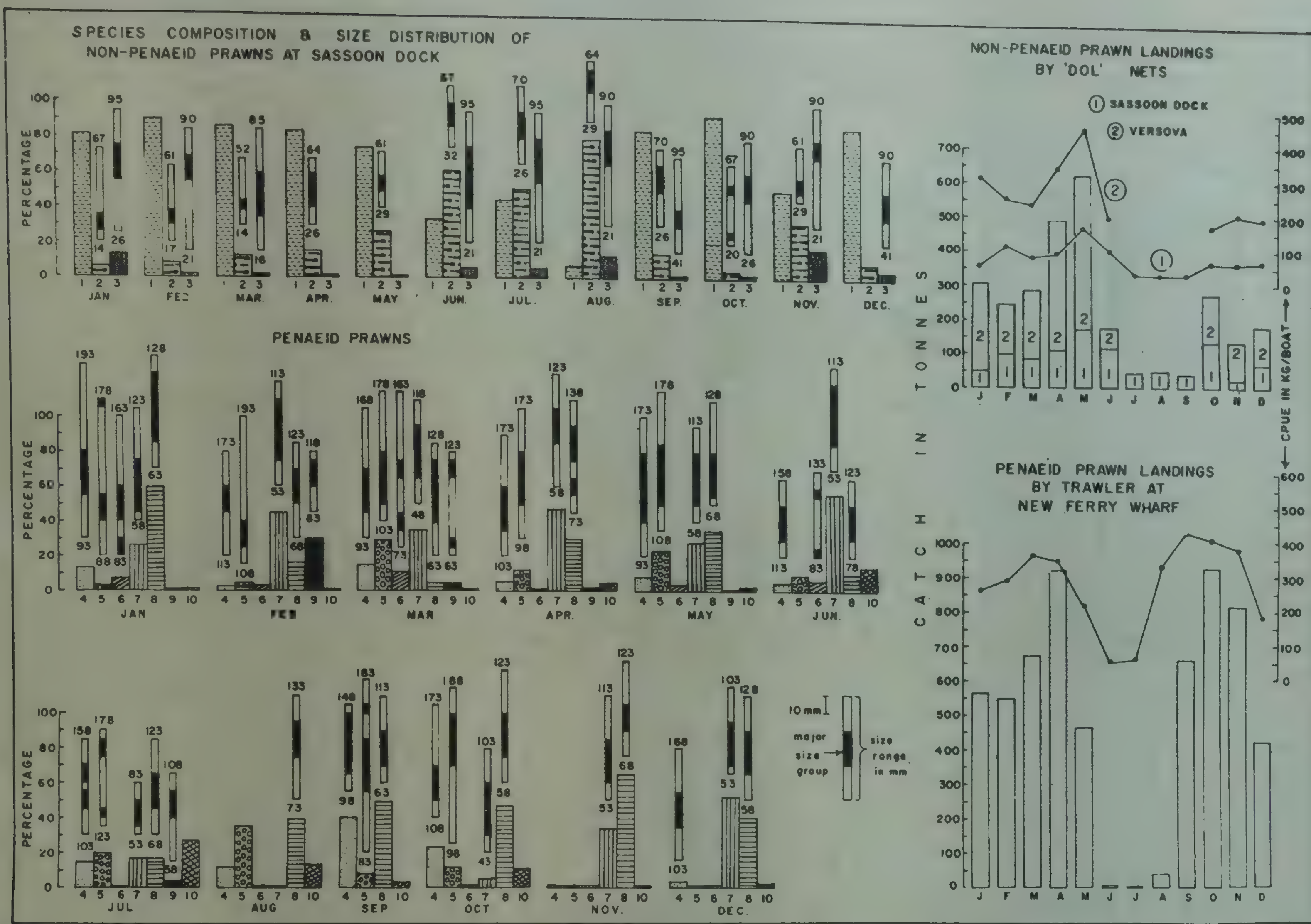

Fig. 3. Catch trend, species composition and size distribution of important species of prawns at Bombay during 1981. *1. A.indicus, 2. N.tenuipes, 3. E.ensirostris, 4. M.affinis, 5. M.monoceros, 6. M.brevicornis, 7. P.stylifera, 8. P.hardwickii 9. S.crassicornis,* 10. Other penaeids.

The non-penaeid prawn catch by 'Dol' nets registered a severe decline during this year in continuation of the previous year. The estimated annual catch for the two observation centres viz. Sassoon Dock and Versova was only 2,862 t as against 4,645 t of 1980 and 5,894 t of 1979. The CPUE worked out to 71.1 kg as compared to 69.3 kg at the former centre, thereby showing marginal improvement. *Acetes indicus* contributed 72% at Sassoon Dock and 66% at Versova, followed by *Nematopalaemon tenuipes* and *Exhippolysmata ensirostris* in the order of their abundance. Maximum percentage of berried females of the caridean prawns was recorded during the second half of the years.

Karwar (Fig. 4)

The fishery was sustained mainly by trawlers at Karwar, contributing nearly 97.1 percent of the total prawn catch. An estimated landing of 584.7 t of prawns was recorded during the year 1981, which showed an increase of about 4% over the previous year when it was recorded at 562.4 t. The peak landing was during April amounting to 179.1 t when the catch per hour registered around 7.4 kg.

M.monoceros, in sizes ranging between 51–135 mm in males and 51–180 mm in females, was dominating the catch by 39.1% unlike the status of thefishery for the previous year, when *P.stylifera* was dominating the catch. In the present year, *M.monoceros was followed by P.stylifera, M.dobsoni* and *M.affinis* representing 29.5, 20.7 and 9.1 percentage respectively. Though the prawn catch has increased during 1981, the catch per hour was very low at 5.7 kg compared to that of 1980 when it was 18.2 kg.

The shore seine, 'Yendi' accounted for a total catch of 21.3 t as against 5.8 t of the previous year, of which *P.stylifera* alone constituted nearly 52.4 per cent, followed by *M.dobsoni, P.merguiensis* and *M.affinis*. There was no landing of *P.indicus* as in the previous year when it accounted for

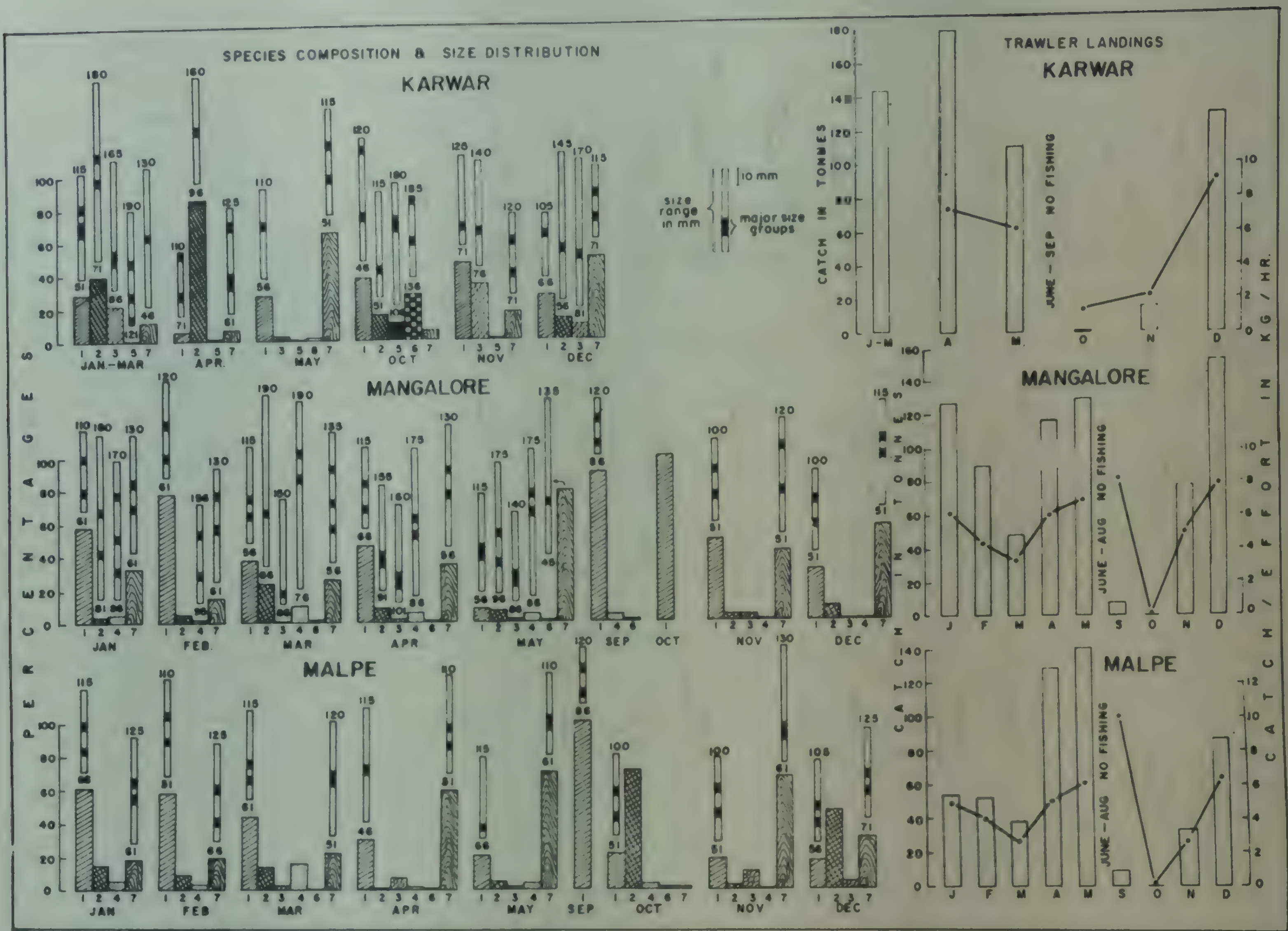

Fig. 4. Catch trend, species composition and size distribution of important species of prawns at Karwar, Malpe and Mangalore during 1981.
1. M.dobsoni, 2. M.monoceros, 3. M.affinis, 4. P.indicus, 5. P.merguiensis, 6. P.monodon, 7. P.stylifera, 8. M.moyebi.

the major share of 44.0 percent.

The matured females of *M.monoceros* were better represented in the months of February and December thereby indicating the spawning peaks (Fig 10)

Malpe (Fig. 4)

The total estimated landing of prawns by trawlers at Malpe was to the tune of 548.9 t. April and May months recorded the maximum catch of 270.0 t which accounted for 49.2 percent. Though the landing in September was very poor, the maximum catch rate was recorded during that month. The overall catch rate per hour for the year was 4.65 kg. *P.stylifera* was the dominant species accounting for 47.2 percent of the total catch, the size range of the species being from 51-130 mm for both sexes, with recurring modes between 81 and 91 mm. The second species in order of abundance was *M.dobsoni* constituting 32.33 per cent, followed by *M.monoceros* of 12.56 per cent, *M.affinis* and *P.indicus* representing 3.72 per cent each in the total prawn landings. *M.dobsoni* was ranging between 46-120 mm sizes.

Relatively high percentage of mature and impregnated females of *M.dobsoni* were observed in the month of September, while those of *P.stylifera were represented in April and November.*

Mangalore (Fig. 4)

The trawl fishing declined during the year with an estimated landing of 752.1 t with the catch rate of 5.8 kg/hr against the total catch of 979.7 t and 6.9 kg/hr of the previous year. The catch per hour has decreased from 7.5 kg of 1979 to 6.9 kg of 1980 and 5.8 kg of 1981. The maximum landing of 153.0 t was recorded during December with the catch rate of 7.9 kg per hour. The CPUE was at the highest rate of 8.3 kg during September but the total landing was very low. The landing of

prawns in October was negligible.

M.dobsoni was the dominating species in the landings, forming 45.5 percent of the total prawns. *P.stylifera* was the next species in order of abundance, constituting 42.0 per cent, followed by *M.monoceros* (6.8 per cent), *P.indicus* (36.7 per cent) and *M.affinis* (1.4 per cent). The size range of *M.dobsoni* was 51–120 mm.

Percentage of mature and impregnated females of *M.dobsoni* was high during March–April and September and those of *M.monoceros* in January and March, *M.affinis* in March–April, *P.indicus* in February and *P.stylifera* during February–March.

Calicut (Fig. 5)

The estimated total catch of prawns by trawlers was 111.6 t with the catch rate of 3.93 kg per hour, and this was obviously far below the recorded landing of 355.0 t with the catch rate of 6.8 kg per hour of the previous year. The highest landing was recorded during December amounting to 48.6 t with the catch rate of 9.1 kg per hour.

Unlike in the previous year, *M.dobsoni* was dominating the trawl catch (56.3 per cent) by relegating P.stylifera to the second position (36.7 per cent) in the present year. *M.dobsoni* was represented in the size range of 56–125 mm, while *P.stylifera* was between 51–135 mm. *P.indicus* accounted for 5.67 per cent in the prawn catch. The monsoon and post-monsoon prawn fishery by indigenous gear yielded an estimated catch of 185.1 t and *M.dobsoni* was the major species accounting for 94.8 percent of the total catch, followed by *P.indicus* (30 per cent).

Cochin (Fig. 5)

The total prawn landing at Cochin was estimated at 2549.5 t with an annual catch rate of 47.5 kg per hour as against the estimated total catch of 3465.7 t with the catch rate of 12.9 kg per hour of

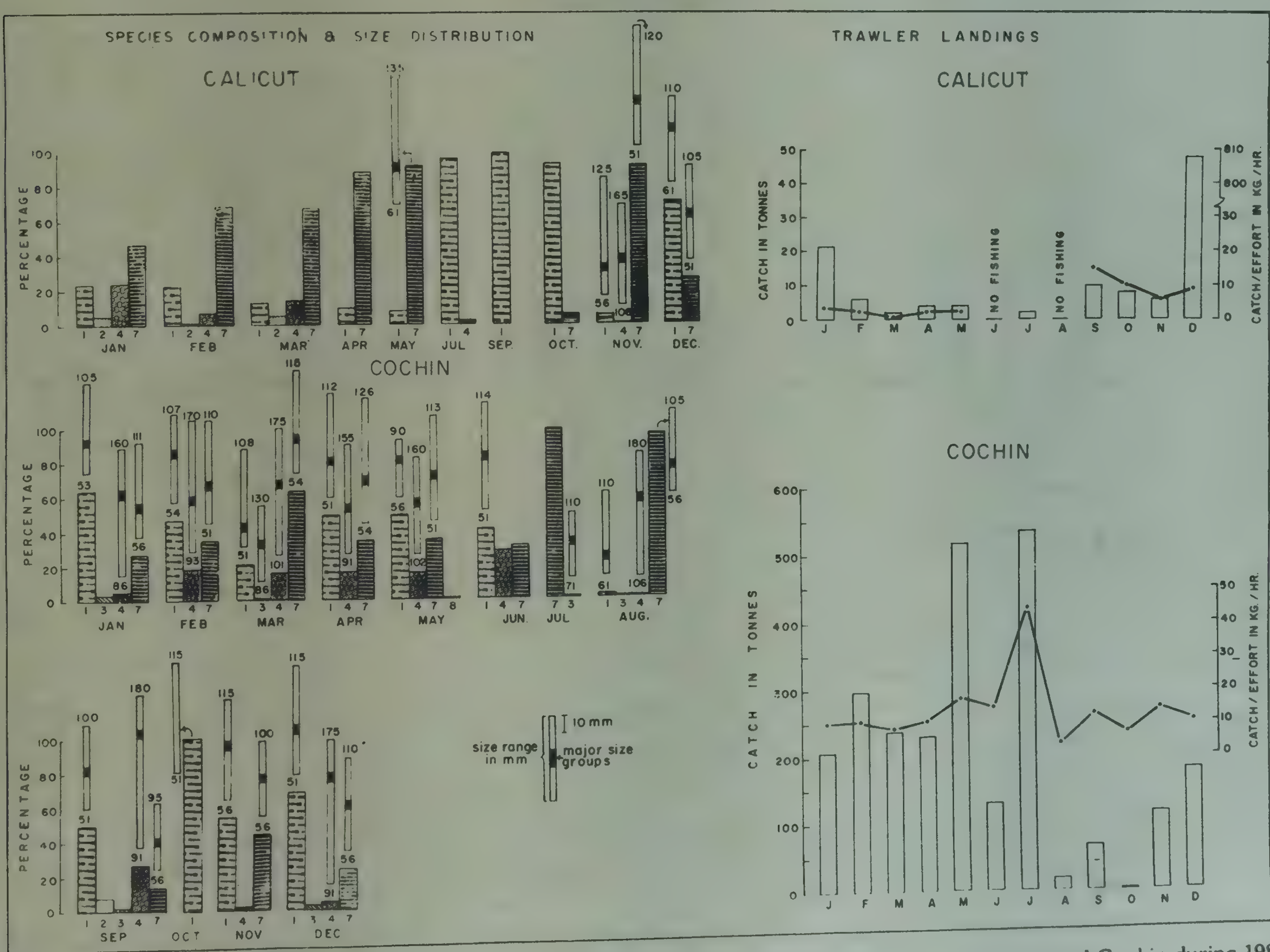

Fig. 5. Catch trend, species composition and size distribution of important species of prawns at Calicut and Cochin during 1981. 1. *M.dobsoni*, 2. *M.monoceros*, 3. *M.affinis*, 4. *P.indicus*, 6. *P.semisulcatus*, 7. *P.stylifera*, 8. Others.

the previous year. May and July recorded the maximum catches of 517.0 t and 530.0 t respectively. Contrary to the dominance of *M.dobsoni* of the previous year, *P.stylifera* was the leading species, accounting for 49.2 per cent followed by *M.dobsoni* (37.7 per cent) *P.indicus* (10.9 per cent) and *M.affinis* (1.1 per cent). August, September and October months recorded lesser catches with gradual increase during December.

P.stylifera in size range of 51–126 mm was represented by both sexes. The dominant size for male was 76–80 mm group while for female it was 81–85 mm. The peak lnding for *P.stylifera* took place during July with a total 528.7 t. The fishery for *M.dobsoni* was at its peak during May when the total catch of the same species was estimated at 251.9 t. Male and females of *P.indicus* were represented in the size ranges of 91–180 mm and 86–180 mm respectively for both sexes. This species occurred in good numbers during February to June, with a peak in May (75.2 t).

In case of *M.dobsoni* higher percentage of mature females (38.7%) were seen in March but impregnated females (31.0%) were observed during May. Maximum percentage of mature females of *P.stylifera* were observed in May (41.0%) and August (37.0%). *P.indicus* showed higher percentage of matured females in January to April (Fig. 10).

Neendakara–Sakthikulangara (Fig. 6)

The total prawn landings at Sakthikulangara amounted to 9399.3 t with a catch rate of 17.7 kg per hour, accounting for 22.5 per cent of the total marine landing. In the previous year the total landing was 36,557.9 t with a catch rate of 43.1 kg.

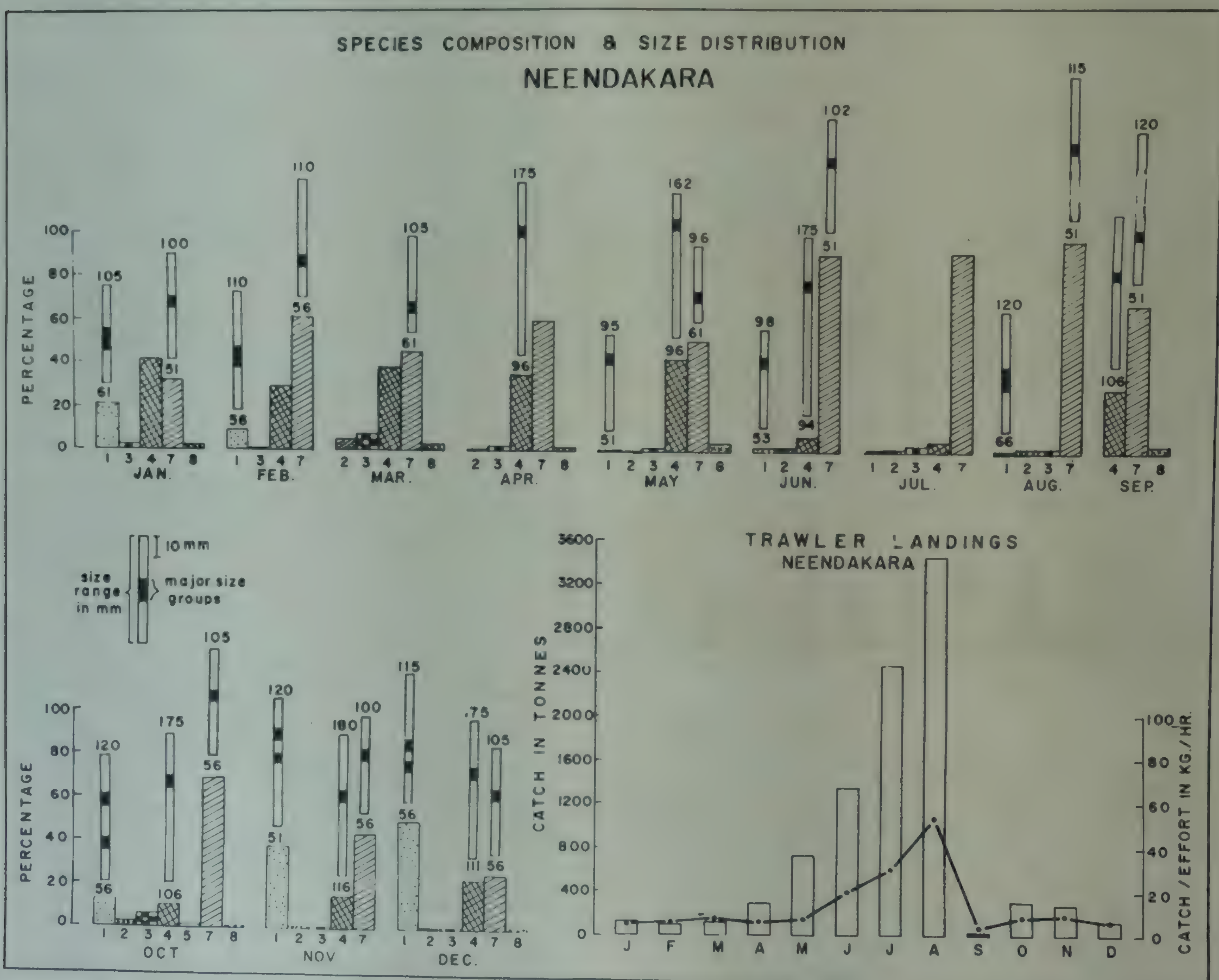

Fig. 6. Catch trend, species composition and size distribution of important species of prawns at Neendakara during 1981. 1. *M.dobsoni*, 2. *M.monoceros*, 3. *M.affinis*, 4. *P.indicus*, 5. *P.canaliculatus*, 7. *P.stylifera*, 8. Other penaeids.

The reduction in the total catch as well as the CPUE implies that heavy rate of exploitation of the species by using more number of boats is taking place in the area, which obviously calls for the measures of judicious exploitation of the resource by limiting the fishing fleet. The considerable decrease in the landing of *P.stylifera* which declined from 33267.7 t (91.0 per cent) of the previous year to 7815.8 t (83.1 per cent) in the present year, was the main reason for the poor status of the prawn fishery. The species next in order of abundance were represented by *P.indicus* 863.2 t (9.2 per cent), *M.dobsoni* (3.5 per cent), *M.affinis* (2.1 per cent) and *M.monoceros* (1.4 per cent). The males of *P.stylifera* were represented by 51-105 mm sizes and females in 51-115 mm. The modes were at 71-75 mm and 81-85 mm for male and female respectively. *P.indicus* was ranging from 96 to 180 mm with a common mode of 151-155 mm for both sexes. Size ranges for *M.dobsoni* were between 51-102 mm for females. The common mode was at 81-85 mm for both sexes.

During May-June period higher percentage of matured females of *M.dobsoni* (37.41%) and in April-June *P.stylifera* (44-51%) were observed in the month of march. Matured females of *P.indicus* were present during June, August and September (Fig. 10).

Tuticorin (Fig. 7)

The prawn fishery during the year 1981 was very good in comparison to that of the previous year. The total catch amounted to 1508.75 t during the year under report as against 404.03 t in the previous year. Although the peak prawn landing period was restricted to the months of June and July the most important constituent species remained to be *P.semisulcatus* (55%), followed by *P.indicus* (44.2%). Record catch of 1080 t was registered in the month of July. *M.dobsoni* formed about 10% of the prawn landings during January--March. The other species of less importance also occurred during this period.

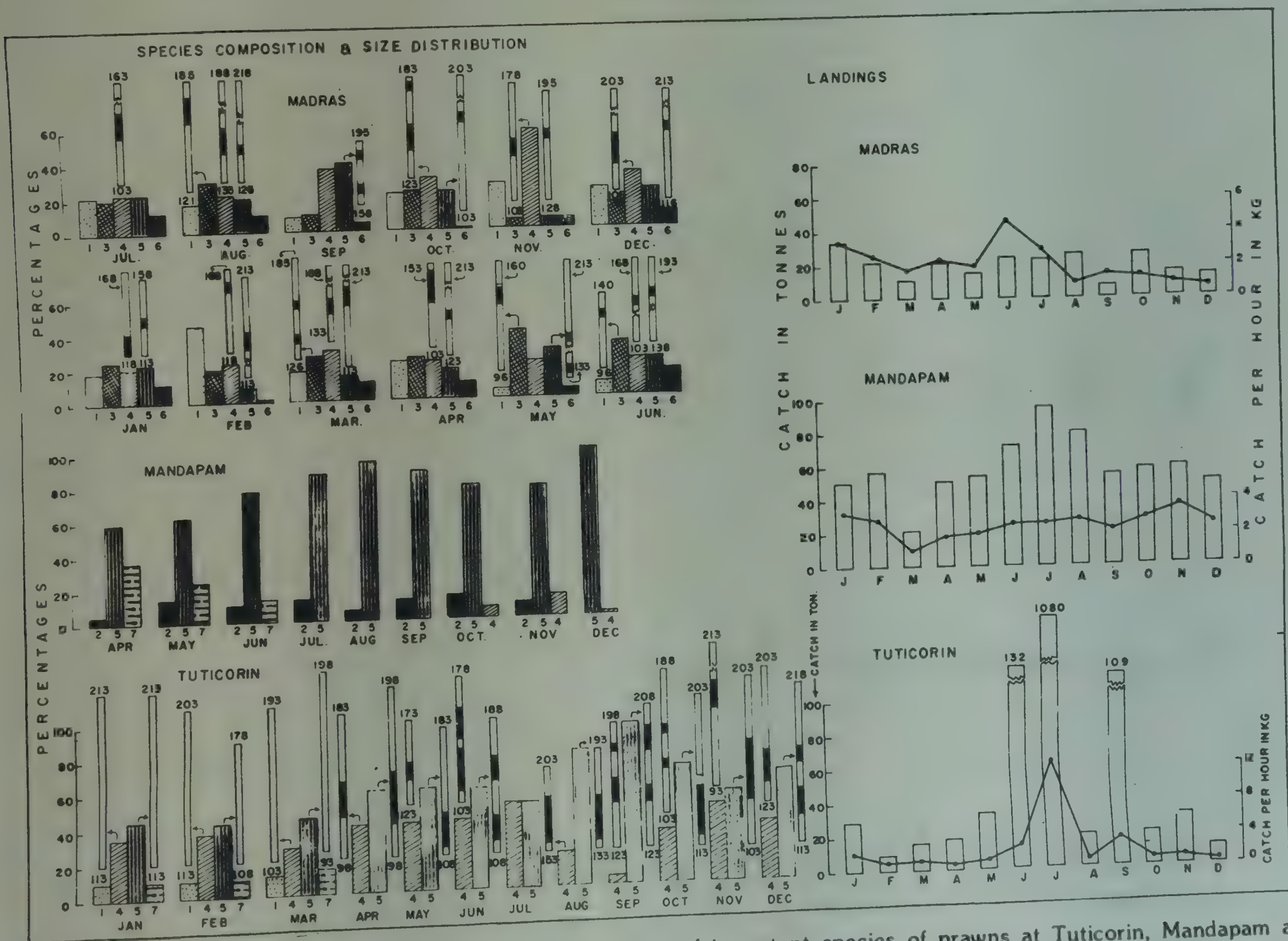

Fig. 7. Catch trend, species composition and size distribution of important species of prawns at Tuticorin, Mandapam and Madras during 1981.
1. *M.dobsoni*, 2. *M.affinis*, 3. *M.monoceros*, 4. *P.indicus*, 5. *P.semisulcatus*, 6. *P.mondon*, 7. Others.

The catch per hour was maximum (12.5 kg) in July while in December it was the least (0.49 kg).

The major size groups represented in the catches of *P.semisulcatus* was 111-195 mm with a size range of 93-218 mm. The spawning activity was at peak during August-November (Fig. 10), during which period 56-91% of the females were with ripe gonads.

Mandapam (Fig. 7)

The prawn landings showed about 1.5 times increase over that of the previous year. Out of the total catch of 707 t about 66.3% was *P.semisulcatuis*. There was considerable difference in the species composition of the catches over the months. During the year under report *M.affinis* which was second in importance formed only 7.6% of the catch while it was about 40% in the previous year.

Although the catch per hour was very poor there was no great fluctuation over the months. It ranged from 0.96 to 3.5 kg, the maximum being in November. The effort also varied from 15914 in January to 37960 in July. The most important constituent of the fishery was *P.semisulcatus* which formed 81.3% of the total prawn catches, the maximum being in the month of July.

Madras (Fig. 7)

The total landings of prawns during 1981 was much more (236.2t) than that of the previous year (173 t). The most important species constituting the fishery was *P.indicus* forming 26.7% of the total landings. This was followed y *M.monoceros* (23.8%), *M.dobsoni* (20.7%), and *P.semisulcatus* (20.2%) in the order of importance. The maximum prawn catch was recorded in January while the percentage of catch of *P.indicus* was highest in November.

The catch per hour ranged from 0.64 kg in December to 4.59 kg in June. The effort expended was maximum in August while it was minimum in September. The major sizes ranged from 116 to 180 mm in *P.indicus* while it ranged from 131 to 190 mm in *P.semisulcatus*. In *M.monoceros* the

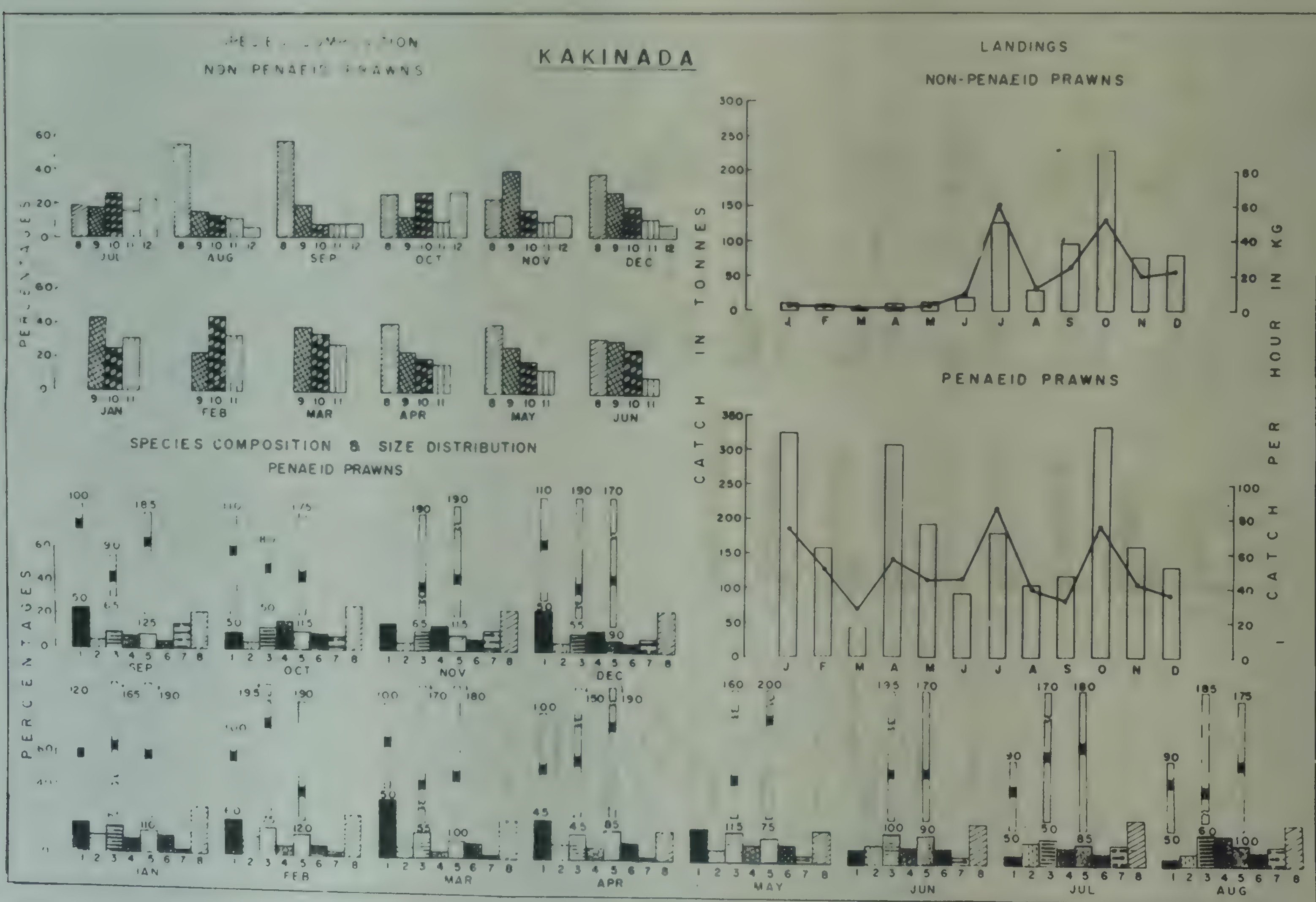

Fig. 8. Catch trend, species composition and size distribution of important species of prawns at Kakinada during 1981. 1. *M.dobsoni*, 2. *M.affinis*, 3. *M.monoceros*, 4. *M.brevicornis*, 5. *P.indicus*, 6. *P.mondon*, 7. *P.stylifera*, 8. Other penaeids, 9. *Acetes* spp. 10. *E.styliferus*, 11. *N.tenuipes*, 12. *E.ensirostris*, 13. Other non-penaeids.

major sizes were in the range 126–175 mm.

The spawning activity was maximum during January–April in *P.indicus* and January–March and August–September in *P.semisulcatus*. But in *M.monoceros* majority of females were with fully ripe ovaries during February–March.

Kakinada (Fig. 8)

The penaeid prawn landings of 1981 amounted to 2155.46 t as against 2396.05 t of the previous year. The maximum catch was recorded in the months of October and January. The catch per unit of effort was ranging from 27.4 kg per hour in March to 85.9 kg per hour in July.

The important penaeid prawn constituents of the fishery were *M.dobsoni* (16.0%); *M.monoceros* (14.5%); *P.indicus* (12.3%); *M.brevicornis* (10.7%); *P.monodon* (8.6%); *M.affinis* (8.1%) and *P.stylifera* (6.3%), in the order of abundance.

The important sizes were 66–90 mm in *M.dobsoni;* 66–150 mm in *M.monoceros*, and 116–170 mm in *P.indicus*. The peak spawning seasons were extended from January to April and August to October and December in *M.dobsoni* while in *M.monoceros* it was February–March, May–August and November–December and in *P.indicus* it was from January to April and September.

The non-penaeid prawn catch during the year under report was 707.77 t consisting of 216.4 t of *Acetes* spp., 150.26 t of *Nematopalaemon tenuipes;* 144.22 t of *Exopalaemon styliferus* and 81.46 t of *Exhippolysmata ensirostris*, the remaining being constituted by the less important species. The catch per hour ranged from 1.20 kg in March to 60.15 kg in July.

Waltair (Fig. 9)

The prawn catch during the year was good (768.26 t). The maximum landing was recorded in February (179.06 t) and the lowest in April (5.78 t). The CPUE range was from 1.1 kg per hour in April and May to 5.01 kg per hour in February. *M.monoceros* formed 41.9%, followed by *M.stridu-*

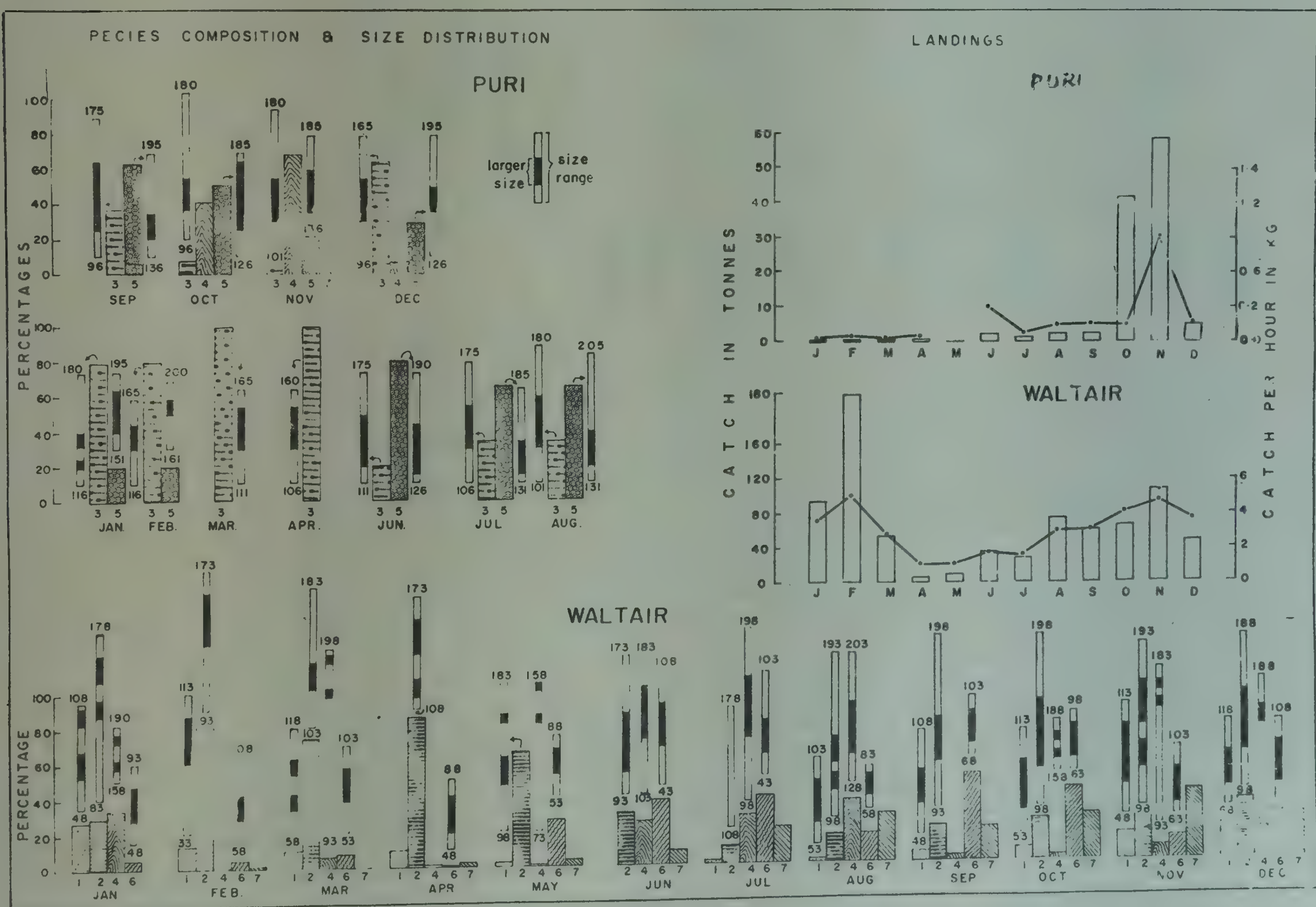

Fig. 9. Catch trend, species composition and size distribution of important species of prawns at Waltair and Puri during 1981. 1. *S.crassicornis*, 2. *M.monoceros*, 3. *M.affinis*, 4. *P.indicus*, 5. *P.merguiensis*, 6. *M.stridulans*, 7. Others.

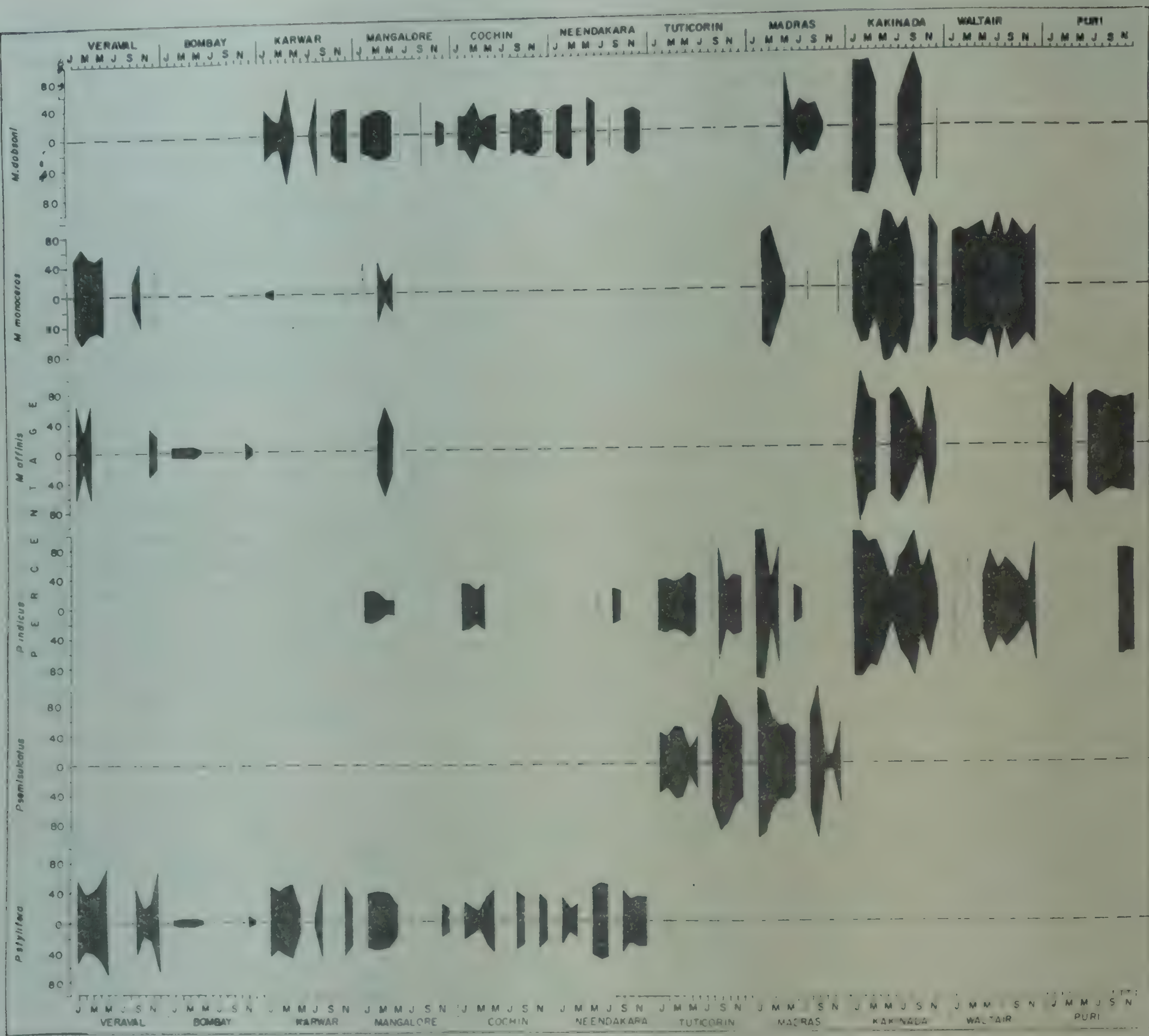

Fig.10. Distribution of the spawning population of important species at selected centres during 1981.

lans (18.3%), *P.indicus* (12.4%), *S.scrassicornis* (11.7%),*M.dobsoni* (6.8%) and *P.monodon* (5.3%). The major sizes were from 106 to 165 mm in *M.monoceros;* 136-195 mm in *P.indicus* and 56-100 mm in *M.stridulans*. The maximum percentages of mature females were recorded during January to May-July and September to December in the case of *M.monoceros* while in *P.indicus* it was during the first four months of the year and in Septemeber and in *M.stridulans* majority of females were immature throughout the year.

Puri (Fig. 9)

The prawn landings by indigenous gears showed a marked increase (114.88 t) over that of the previous year (52.07 t), coming close to the landings of 1978. The catches were poor during the first four months, but picked up by August and reached maximum in October-November period. The catch per hour was very poor in most of the months except in October and November (0.87 and 1.13 kg/hr).

The species composition was also slightly changed during the year. *P.mondon* formed a fishery of very little magnitude during October--December. *P.indicus* was also present only during this period. Otherwise, the most important species remained to be *P.merguiensis,* followed by *M.affinis* while the latter was the dominant species in the previous year.

The major sizes were 111-155 mm in *M.affinis*

and 131-190 mm in *P.merguiensis*. In *P.indicus*, 146-170 mm was dominant size.

The females of *M.affinis* were mostly ripe (57.58-79.31%) throughout the year; but the peak spawning period was during the months of January, April and July when more than 70% of the females were with ripe ovaries. In *P.merguiensis*, the condition of maturity was more or less similiar with peak season in January-February, August and December, crossing the 70% mark.

EARNING BY LEARNING AND DOING **

The Krishi Vigyan Kendra (Farm Science Centre) for mariculture was established at Narakkal in December 1976 with a view to transfer the aquaculture techniques developed in the laboratory to the end users. Till date the Kendra has trained more than 1,300 farmers in Prawn and Fish culture. A follow-up survey to evaluate the impact of the training programme and the mode of utilisation of the technology among the trained farmers was conducted for the second time in 1981. The results indicated that 73% of the farmers have utilised the training in one way or another. This article, on the success story of a harijan youth, is one among the many to be published in MFIS.

.....OFFICER-IN-CHARGE, KVK, NARAKKAL

Mr.N.K.Sudhakaran, a harijan youth of Nikathithara house, Narakkal is an agriculture labourer. He is aged 28, married and with a daughter. His family is put up in a tiled house in a ten cents plot amongst prawn filtration fields, not far away from the Government Fish Farm, Narakkal. Sudhakaran, as professed by his ancestors,has been deeply involved in the traditional system of 'Pokkali' rice cultivation and subsequent prawn filtration in the fields of his landlord.

Way back in 1979, one of his well-wishers, who had undergone one month's training in Prawn and Fish culture from the Krishi Vigyan Kendra, Narakkal had an opportunity to casually discuss with Sudhakaran the merits of scientific prawn culture from what was learned and seen during the training programme. Sudhakaran felt sorry for his friend and his remark at that time was that his friend has been brain-washed by the KVK. This harijan youth believed that the scientific prawn culture programme was a highly expensive operation and that only big landlords and moneyed farmers could do it.

In those days, 'naran', (*Penaeus indicus*) culture was just on the move and farmers were suspicious of that operation. The results from two neighbouring canals, where 'naran' culture was conducted made Sudhakaran think and though with hesitation decided to enter into the trade. Thus, he collected some guidance from his friend and stocked a nearby canal of 0.2 ha with 15,000 'naran' seeds. After about three months, the canal was harvested and to his disappointment nothing

**Presented by K.N.Rasachandra Kartha, KVK, Narakkal with permission of N.K.Sudhakaran, Nikathithara House, Narakkal.

except few kg of Tilapia and *Metapenaeus dobsoni* (Thelly) could be obtained.

With the failure of the maiden attempt, Sudhakaran visited the KVK and narrated the whole story. He was advised by the staff to undergo the training course and was selected for the 33rd course of 15 days duration.

After successful completion of the training programme from 8th to 24th November 1979, he fixed a minisluice gate in the leased canal, physically eradicated the predatory animals and stocked it again with 18,000 numbers of 'naran' seeds, collected from nearby backwater areas. Being badly in need of money, the canal had to be harvested after 61 days of culture operation. To his surprise, he could get 136 kg of 'naran' which was sold for Rs. 1,632.00 at the rate of Rs. 12.00 per kg. (Sudhakaran says that the market value of prawns on

that occasion was the lowest). Taking into account the effort expended by him and also the cash down payment, the total expenditure worked out to Rs. 1,050.00. Thus he could earn a net profit of Rs. 582.00

Encouraged by this, he determined to continue the programme. During January 1981, Sudhakaran leased in a bigger canal of 0.6 ha and after preparing it, stocked with 60,000 numbers of 'naran' seeds, brought from Puthuvaippu. After waiting for 2 months, the stock was partially harvested for bigger prawns and 60 kg of 'naran' valued at Rs. 1,500.00 was cast-netted. Subsequently on 14th April, 1981, the final harvest was conducted in which 200 kg of 'naran' valued at Rs. 3,420.00 was realised, bringing the total income to Rs. 4,920.00 from a single culture operation. The net income to Sudhakaran was Rs. 3,400.00. He had to surrender the canal back to the landlord as the lease period was to expire on the last week of April.

Mr. Sudhakaran is at present fully engaged in 'naran' farming. When contacted for details of his recent harvest, he had a word of request that some arrangement may be made by the KVK or any other government agencies for the timely supply of 'naran' seeds. According to him, if this is implemented, it would go a long way in the full utilisation of the entire canal water system, hitherto lying idle amongst the coconut groves of Vypeen island.

Literate, with a pass in VII standard, Sudhakaran operates an account in the local bank at present. He is thankful to the KVK for bringing him to the present status where he has a place in the society.

* * * * * * * * *

PROVEN TECHNOLOGY

INDUCED MATURATION OF PRAWNS FOR PRODUCTION OF SPAWNERS FOR HATCHERIES

High lights:

Spawners for hatchery production of prawn seeds were always collected from the commercial fishing grounds where they are known to mature and spawn. The collection of these spawners from the sea has been a serious problem as their availability is not only seasonal and uncertain but their procurement and transport expensive. The researches carried out at the NPCL of CMFRI have made it possible to mature and develop the spawners from the farm reared prawns. Adult prawns taken out from the grow-out ponds of the farm are subjected to unilateral eyestalk ablation and treated in special broodstock development pools where they attain full gonadial development and become ready to spawn. Using this technique several generations of the Indian White prawn *Penaeus indicus*, that have not gone to the sea during any phase of their life cycle, have been grown in the NPCL farm.

Operational details:

Large sized *P.indicus* (over 140 mm in size) caught from the grow-out ponds are acclimatised in 32-34 ppt settled and filtered seawater kept in one ton capcity plastic pools for a day. After acclimatization the females are selected and one eye-

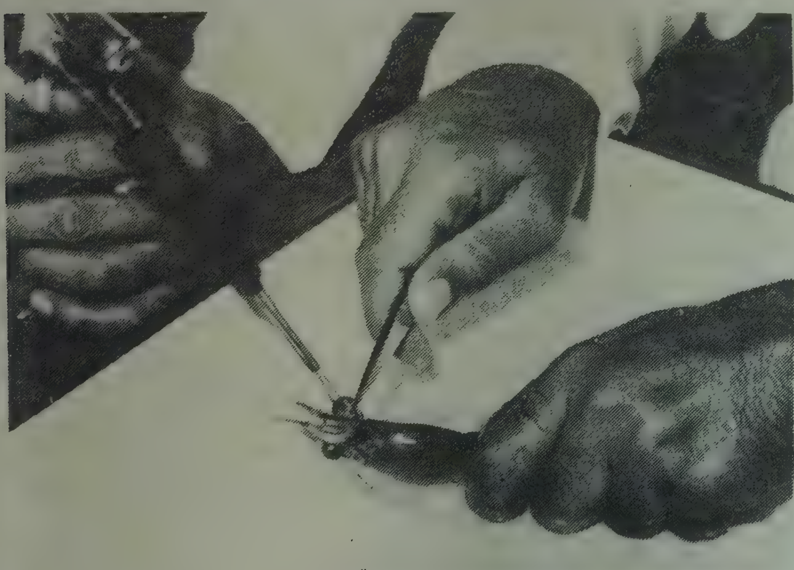

Fig.1. Unilateral eyestalk ablation by electric cauterisation at Narakkal Prawn Culture Laboratory.

stalk of each of them is removed by using an electro-cautery apparatus (Fig.1). Mortality caused by the procedure is negligible. The cauterised females and half the number of acclimatised males

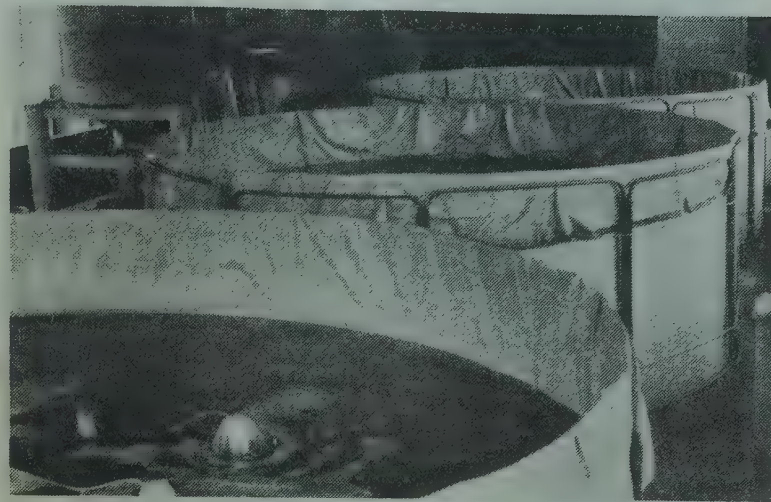

Fig. 2. Brood stock pools at NPCL

are transferred to the maturation facility for gonadial maturation. The facility consists of 10 ton capacity circular seawater tanks fitted with sub-gravel biological filters with air-lift recirculation arrangement for maintaining the quality of the seawater (Fig.2). The biological filter converts the toxic ammonia excreted by the prawns into relatively harmless nitrates and maintains water quality. The pH of the seawater is adjusted to remain at 8.2. The prawns are fed *ad libitum* with fresh clam meat. Under these conditions the females mature within 3-5 days after eyestalk removal and then they are transferred to the spawning tanks of the hatchery. About 75% of ablated females develop mature ovaries and spawn viable eggs.

Production:

40 females and 20 males of *P.indicus* are kept in a 10 ton capacity broodstock pool. On an average 30 spawners will be ready for spawning in 3-5 days and each spawner will produce not less than 1,00,000 nauplii i.e. 3 million nauplii from each pool. If daily production is required the number of broodstock pools should be increased to 5 or 6. At present, NPCL has 3 broodstock pools.

Inventory and cost:

The maturation facility is to be considered as part of a hatchery meant to produce prawn seeds. The special inventory required for the maturation facility for a daily production of 3 million nauplii consisting of pools, filters, compressors,pumps, chemicals and testing equipments will cost around Rs. 0.5 million; the land and building will cost

around Rs. 0.5 million and contingencies including salary component, labour, maintenance, feed, seawater pumping cost, etc. will cost around Rs.0.5 million; totalling to about Rs.1.5 million. However this cost can be considerably reduced when the project is undertaken as part of a hatchery project.

Estimated cost of production:

It is difficult to estimate cost of production in view of the fact that the broodstock pools form part of a hatchery utilizing many of its general facilities. However the production cost per spawner may not exceed Rs.5.

Prospects:

A maturation facility, as an integral part of the hatchery, ensures a steady supply of spawners and helps efficient planning of hatchery operations to produce prawn seeds on a large scale. In a developed state it may be possible to sell spawners to nearby hatcheries or even sell newly hatched nauplii to those having only rearing facilities.

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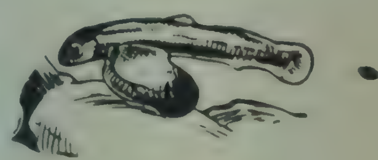

NEWS-INDIA AND OVERSEAS

Stranding of a sperm whale at Tranquebar

Sperm whale, *Physeter macrocephalus* Linnaeus, which is a synonym of *P.catodon*, the largest of the toothed whales is oceanic and cosmopolitan in distribution. They are found in Atlantic, Pacific and Indian Oceans. The earlier records of the species from Indian seas is mentioned in the report on a stranded young specimen from near Quilon in *Mar. Fish. Infor. Serv. T & E Ser.* 25 p. 14.

On 8th June, 1982, evening at 3 p.m. the fishermen at Pudupatinam, near Tranquebar noticed a whale in the sand silt surf region struggling to get back into the sea. The animal was making some distress calls and blood mixed with water was oozing out through the dorsal slit. Some fishermen tied the animal to a mechanised boat and towed it to the shore, where it died after 12 hours.

Fig 1. Stranded sperm whale at Tranquebar.

The stranded whale was found to be an young male measuring 9.06 m (Fig. 1), estimated to be five years old and weighing about 6 tonnes. Although whales are known to have good sense of direction using sonar, they may yet find themselves stranded occasionally while pursuing their prey in shallow areas and gently shelving beaches due to some error in navigation.

The sperm whale has massive barrel like head, which is blunt and accounts for about a third of the animal's length and behind it the body tapers to the tail flukes. The lower jaw is very narrow and does not reach the end of the snout. On the lower jaw, there are two rows each of fourteen unerupted and six erupted teeth. The upper jaw is devoid of functional teeth and it carries few (4 to 5) rudimentary teeth in the gum which is tough and rubbery with a number of sockets into which the teeth of the lower jaw fit when the mouth is shut. The blow hole lies near the front of the forehead. The colour of the whale was jet black with flippers lighter in shade. The body measurements of the specimen are given below:

Morphometric Characters	Measurement(cm)
Total length (Snout to the tip of caudal)	906
Standard length (Snout to the caudal peduncle)	819
Fork length (Snout to notch of caudal flukes)	879

Tip of snout to origin of dorsal fin	302
Length of dorsal fin base	57
Tip of snout to anterior insertion of flipper	269
Flipper length	36
Outer curvature length of flipper	52
Maximum breadth of flipper	39
Tip of snout to bifurcation origin of lower jaw	142
Notch of flukes to centre of anus	190
Tip of snout to blow hole	134
Breadth of snout	106
Length of upper jaw	131
Length of lower jaw	128
Length of blow hole	15
Breadth of blow hole	5
Tip of snout to centre of eye	195
Eye diameter	8
Tip of snout to centre of anus	549
Preorbital length	195
Distance from centre of anus to caudal fork	190
Anus length	11
Anus breadth	6
Tip of snout to origin of genital organ	465
Length between genital region and anus	64
Length of penis	77
Diameter of the penis at the base	54
Diameter of the penis at the middle	27
Diameter of the penis at the tip	7
Number of rudimentary teeth in the upper jaw	5
Number of erupted teeth in the lower jaw	12
Number of unerupted teeth in the lower jaw	28
Height of the body	241
Body depth near head region	448
Depth at origin of flipper	482
Depth at origin of genital region	434
Depth at caudal peduncle	202
Estimated weight	6 tonnes

On the eighth day of its stranding, the whale was cut open. The stomach contents consisted of 158 beaks of squids, 15 undigested squids and other semidigested sea grasses. About 50 litres of oil was extracted from the blubber from the body collected by the Tamil Nadu Fisheries Department, Tuticorin. The whale was burried in order to retrieve the skeleton for the Museum of the Mandapam Regional Centre of Central marine Fisheries Research Institute, Mandapam Camp.

Reported by P. Nammalwar and V. Thanapathi.

Baby lobsters from France released in the Mediterranean

The first batch of 10 month old lobsters, numbering about 25,000 were released in the Mediterranean Sea during this year. The baby lobsters, young ones of the European lobster *Homarus gammarus*, came from the Ile d' Yeu hatchery in southern Brittany and were released in the Bouches du Rhone area as part of the region's fishery and aquaculture programme.

French scientists involved in the work preferred midday for release of the lobsters while their British counterparts working on the project earlier favoured night time for release as they considered darkness as a protection against immediate predation.

Fish Farming International 9(5): July 1982

Fish without sex grows faster

Reports in the journal International Agricultural Development indicate that Scottish scientists at Aberdeen University in U.K. have developed a simple method for sterilising fish which they report would make them grow fatter. The idea is that fish without sex would put all their energy into growth, resulting in more weight for the fish. The technique will allow production of fish double the present size without any change in feeding pattern.

Existing methods for sterilising fish involve direct surgery, which is time consuming,or the use of hormones, which poses health hazard. The researchers took a cue from a fertility disease of bulls involving rapturing of testes. They found that the damaged testes produce chemicals which stimulate the animal's immune system to reject the reproductive organs. Drawing a parallel the scientists ground up the ovaries and testes from fish and injected a small quantity into a young male salmon trout. The experiments showed that the immune system of the young fish rejected the foreign tissue and simultaneously its own sexual organs because of their similarity. The technique was equally effective with young female fish as well. Experiments are in progress to prove the possibility of the faster growth in these sterilised fishes. According to the report of the scientists the technique would hold good for other species of fishes also.

Compiled and prepared by M.J.George, G.Subbaraju and S.K.Dharmaraja.
Published by Dr.M.J.George, Senior Scientist on behalf of the Director, Central Marine Fisheries Research Institute, Cochin-682 018. Phototypeset and printed at PAICO, Cochin 31.

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Abbreviation—Mar. Fish. Infor. Serv. T & E Ser., No. 44 : 1982.

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Cover photo: Damaged and grounded boats at Madhwad in Gujarat.

CYCLONE DEVASTATION ALONG SAURASHTRA COAST OF GUJARAT IN NOVEMBER 1982

G.Sudhakara Rao and K.K. Datta.

A severe cyclonic storm with a wind velocity of 150 km per hour swept through the coastal districts of Junagadh, Amreli and Bhavnagar of Saurashtra (Fig.1) on the afternoon of 8th November 1982 leaving behind a trail of destruction along its path. It is reported to be the worst of its kind in the living memory of the local people and has taken a toll of 550 human lives and 2 lakhs heads of livestock. About 2 lakh huts were completely damaged and about an equal number of pucca houses were either partly damaged or destroyed. Thousands of trees were uprooted and electric and telecommunication poles got twisted. Communication was totally disrupted and the three districts were plunged into darkness. Amreli district was the worst hit with a death toll of 265. The cyclone played havoc with the garden crops like banana, coconut and sugarcane. While the cyclonic winds and incessant rains inflicted heavy damage along the coast, flooding of lowlying areas due to overflowing and breaching of dams devastated the inland villages taking a heavy toll of human beings and livestock.

The course of the cyclone was monitored precisely by the Colaba Observatory since 5th November. The storm developed in the Arabian sea was to touch Bombay on 6th November. But it had changed its course by 6th evening and it was predicted that it would touch South Gujarat. A further change in the course indicated that it was picking up momentum and would cross the land somewhere along the Saurashtra coast by 8th November with wind velocity of 150–200 km per hour. By 8th morning it was certain that the storm would cross between Diu and Veraval by the forenoon of the same day. As predicted the cyclone touched the land at Madhwad, a fishing village about 50 km from Veraval, with a wind speed of 150 km and passed through Kodinar, Amreli and Bhavnagar. Its full force was felt between Jaffrabad and Veraval along the coast. The whole area had been experiencing intermittent heavy rains since 6th evening and the intensity increased by 8th noon. The entire town of Veraval was flooded with rain water and in some places as much as 5 feet of water was flowing

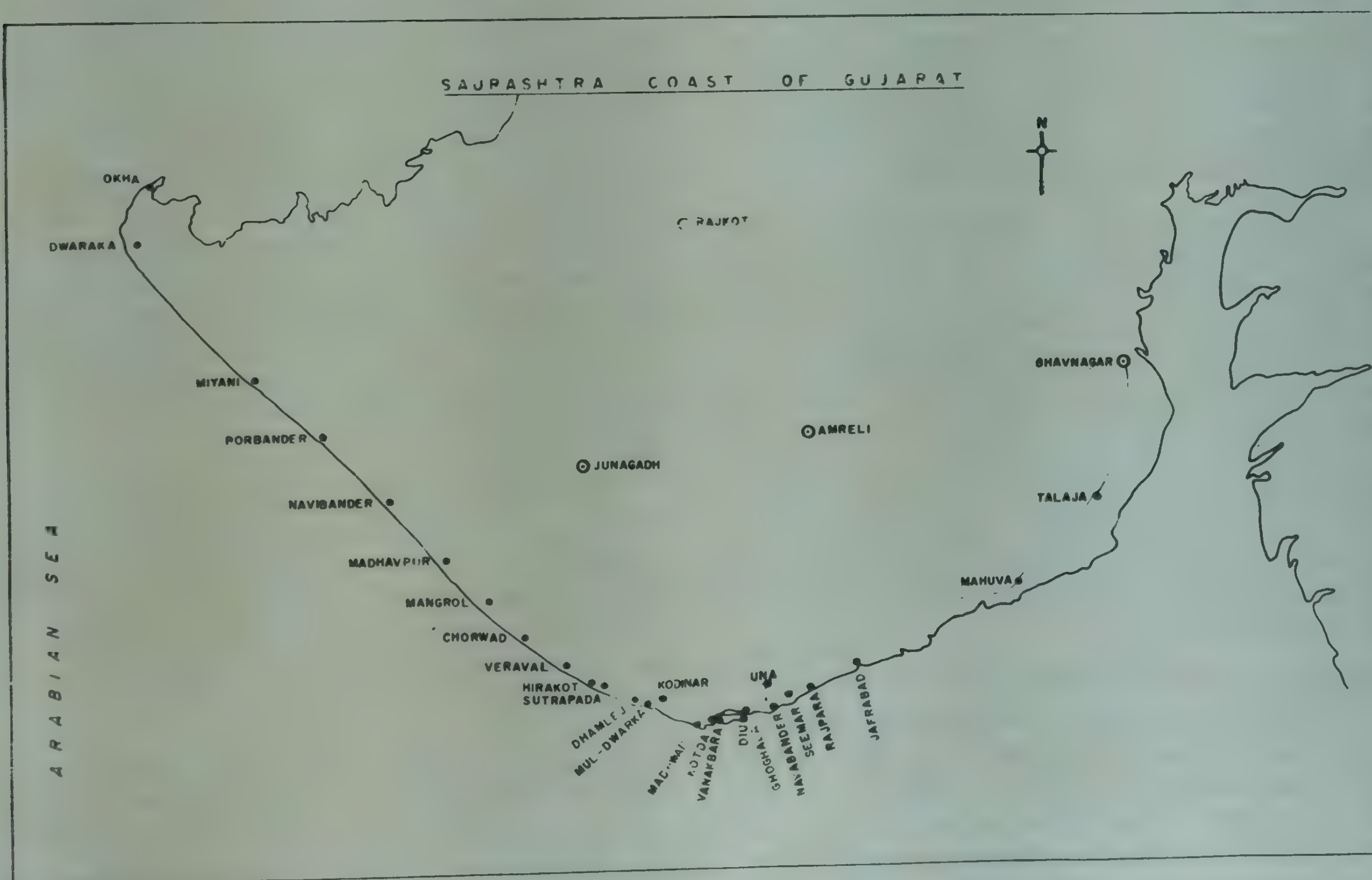


Fig. 1. Map showing the fishing villages affected by the cyclone along Gujarat coast.

Table.1. *Districtwise extent of loss and damage to small scale fisheries along the coast of Gujarat (Value in '000 Rs.)*

District	Loss of human lives	Damages to houses		Loss of boats		Damages to boats		Loss of nets		Loss of fish materials (Value)	Total loss (Value)
		No.	Value	No.	Value	No.	Value	No.	Value		
JUNAGADH	3	3210	5363	40	1213	433	1852	817	784	11082	20294
AMRELI	15	365	571	11	310	112	783	949	312	—	1976
DIU	6	330	230	10	383	59	204	5	32	80	929
Total	24	3905	6164	61	1906	604	2839	1771	1128	11162	23199

on the roads. Veraval had 23 cm rain fall on the 8th of November. The coastal areas had a sigh of relief by dusk as the wind subsided while the inland areas of Amreli and Bhavnagar districts continued to have rough weather in the night.

Government machinery was geared up to meet the eventuality. By 8th morning radio broadcast and local announcements were given to keep the people on the alert. The army and airforce were also informally alerted to stand by in the rescue and relief operations. In spite of all the precautionary measures, there was extensive damage to public and private properties due to the cyclone and the loss was estimated at Rs.260 crores. The loss to crops, livestock, fisheries and forestry alone would be to the tune of 150 crores.

There was extensive damage at Veraval as many of the houses collapsed and all communications got cut off. Port department suffered a damage of Rs.40 lakhs. Nine of the barges drifted to high seas and sank and heavy damages were caused to godowns and machinery. World Bank fishery harbour project lost about Rs.40 lakhs as 45 cm of western break-waters and 90 m of eastern break-waters were washed away because of wave action. The coffer dams built to facilitate dredging in the inner basin were breached. The auction hall and gear mending hall built under the scheme were heavily damaged.

Damages in fishing villages (Figs 2-13)

The fisheries sector is one of the worst affected in the cyclone especially in the districts of Amreli and Junagadh and the Union territory of Diu. The districtwise details of the damages are given in Table 1. The fish landing centres affected are shown in figure 1. 61 boats were lost and about 600 boats, mostly country crafts fitted with outboard engines or inboard engines, were damaged inflicting a loss of about Rs.47 lakhs. Gears, mostly gillnets and dol nets accounted for a loss of about Rs.11 lakhs. About 3900 huts were either blown off or damaged, the extent of damage being about Rs.62 lakhs. Processed fish material-dry fish, fish meal, prawns and squids-worth Rs.112 lakhs was spoiled because of godown collapses and power breakdown.

Madhwad, a fishing village in Amreli district, about 50 km south of Veraval, was the worst hit with 14 lives lost and damages to fishing boats and fishermen houses. About 25 houses were completely washed away because of tidal action. Some of the persons who ventured out of the villages to reach safer elevated places were swept away by tidal water and gales. Almost all the houses were damaged and the boats which were moored in the bay were let loose by the tidal action and drifted helter-skelter. Those that drifted to inland areas ran aground when the tidal water receded after the fury of the cyclone. The total loss was estimated at Rs.10 lakhs.

Mul-Dwarka, another fishing village in Amreli district about 40 km south of Veraval also suffered extensive damage with an estimated loss of Rs.5 lakhs. About 20 houses in the sea front were swept away along with the belonging of the fishermen because of erosion due to tidal action. About 790 pieces of gill net were also swept away.

Union territory of Diu also had severe damage. A trawler with 3 crew drifted into the sea, resulting in the loss of all of them. Another boat, a dolnetter, drifted with 3 crew and sank, killing all the occupants. The total losses at the four fishing cen-

tres of Diu, namely Diu, Ghoghakla, Seemar and Venakbara are to the tune of Rs.9 lakhs.

The dol net fishing zone mainly consisting of the three landing centres Jaffrabad, Rajpara and Nawabunder in Junagadh district has also suffered extensive damages, the loss being estimated at Rs.58 lakhs. Five boats and 84 dol nets were lost. About 2400 huts were blown away by the wind, exposing dry fish stock worth Rs.31 lakhs and resulting in their spoilage.

Damages in fishing harbours

The full fury of the cyclone was felt at Veraval where waves of 3-4 m hight lashed the coast tossing the fishing vessels in the harbour. Thirteen canoes were lost and 31 trawlers sank in the harbour due to a breach in the cofferdam and subsequent gushing of flood waters into the harbour. However all the 31 trawlers were refloated with the help of cranes and manual dewatering. About 131 boats were damaged inflicting a loss of Rs.9 lakhs to the industry. Unlike the 1981 cyclone, this year the brunt of the fury was felt by the fishing industry. Almost all the buildings and sheds of fish freezing plants, fish meal factories and dryfish traders were heavily damaged at Veraval with an estimated Rs.123 lakhs loss to the industry (Table.2). Buildings, machinery and freezing material worth Rs.63 lakhs were lost. A number of fish meal factories were damaged and the loss was estimated at 44 lakhs. Worst affected are the dryfish traders who lost all their godowns, sheds and dryfish, the loss estimated at Rs.17 lakhs.

The fishing industry at Porbandar and Mangrol which was greatly affected in 1981 cyclone felt only a fringe of the fury of the present cyclone and escaped with minor damages. At Porbandar a trawler sank in the sea and the crew managed to escape. About 5 boats were damaged. The loss was estimated at Rs.2 lakhs. At Mangrol about 70 boats were damaged incurring a loss of Rs.1 lakh.

Table.2. *Losses to the fishing Industry at Veraval (Value in '000 Rs)*

Item	Freezing Plants/ Ice factory	Fish meal factories	Dry fish Traders	Total
Buildings	1304	1759	365	3428
Machinery	327	262	—	589
Frozen material	4417	—	—	4417
Dry fish	—	—	1274	1274
Dry fish for fish meal	—	1350	—	1350
Fish meal	—	917	—	917
Others	243	78	38	359
Total	6291	4366	1677	12334

Loss due to suspension of fishing

Assuming that the catch trend during the period when fishing was suspended due to the cyclone remained the same as in few days prior to the havoc, the expected catches of fish were worked out for each district. The loss was estimated at Rs.442 lakhs (Table.3.)

Table. 3. *Expected loss due to suspension of fishing after Cyclone*

Name of the District	No.of days fishing suspended	Expected quantity lost (in tonnes)	Loss in Value ('000 Rs)
JUNAGADH	15	13170	36676
AMRELI	22	1914	4124
DIU	12	1428	3416
Total	—	16260	44216

Relief measures

The Government of Gujarat has taken prompt relief measures to rehabilitate the displaced persons, to provide essential commodities and to resume power supply. Prompt action was taken in clearing the roads to provide communication system and to supply essential goods to the affected persons. Fresh water was supplied by tankers in towns and villages. About 48 towns and 2,000 villages were in darkness for days together. Due to prompt action power supply has been restored to 38 towns and 1,343 villages within a fortnight. Power generators were pressed into service in remote towns to run flour mills and other essential units to avoid inconvenience to the public. However, it would take same more time to restore the normal power system as the damages were extensive. Medical teams were sent to all the areas to prevent spreading of epidemics. About 2 lakh doses of anticholeras vaccine have been despatched to the affected areas.

Government agencies have distributed Rs.3.5 lakhs as cash assistance to the families of the persons killed in the calamity and Rs.50 lakhs have been distributed as assistance in kind. Central

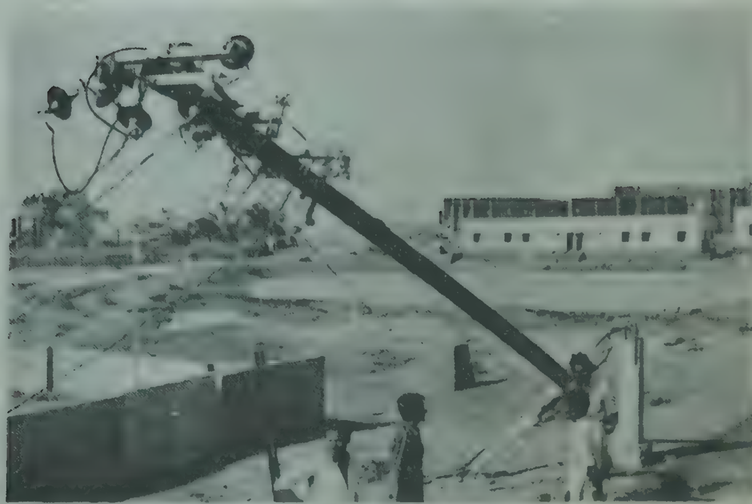


Fig. 2. Fury of the cyclone bent electric poles.


Fig. 3. Road in Veraval after flood water receded.


Fig. 4. Damaged Municipal market of Veraval.


Fig. 5. Damaged roadside shops in Veraval.


Fig. 6. Boats damaged in Veraval fisheries harbour.


Fig. 7. Lifting sunken trawlers by crane at Veraval.

Fig. 8. Uprooted coconut trees.

Fig. 9. Gear mending Hall in Fishery Harbour Project.

Fig.10. Damaged building of a freezing plant.

Fig.11. Houses in heaps.

Fig.12. Boats among huts at Madhwad.

Fig.13. Grounded boats.

Severe cyclone may hit Bombay

Express News Service

PUNE, Nov 6

severe cyclonic storm is acingly advancing towards West Coast from the Ara- Sea, and Bombay falls in

servatory, the severe storm will start adversely affecting the coast from Monday morning. It is still not clear which part of the coast it will strike, since storms tend to behave in the erratic manner,

Cyclonic storm heading for S. Gujarat

HMEDABAD, Nov 7 (PTI, UNI)

he activities in coastal ages and towns of the ith Gujarat came to r standstill this even- following impending

The rainfall was caused unde the influence of severe cycloni storm which was situated abou 800 kms south-west of Bomba at 1730 hours yesterday an which is likely to cross th South Gujarat coast betwee Harnai and Bulsar tomorro afternoon.

Fishermen in coastal village of South Gujarat and Saurasl warned again

Storm toll 487 76 still missing

By Our Staff Reporter

GANDHINAGAR, Nov 18

The death toll in last week's clone in the State rose to this morning. tating this here today.

ernment had so far disbursed Rs 40 to Rs 42 lakhs as cash doles and other reliefs to the cyclone victims. Mr Raval said that the Central team to assess the cyclone damage was likely

Nature's fury haunts Amreli re

y SAIBAL DASGUPTA

xpress News Servile

AMRELI, Nov 18

cyclone victims of Amreli know which of the two final blow — the cyclone the neck-high sheet of at gushed out of the ri- ll they know is that they ldenly exposed to the ty- nature on the fateful the walls of their houses rumbling. And the battle d for survival.

Madha of Wankia village ly braced up for the fight d to pull out his family through the roof, as the jammed shut by the im- e wind. The family of quivering on a raised made by stacking sacks ver a huge metal trunk

nished his task before all gave in. He broke wooden plank that sup- roof by banging his t it. Once

Amreli not likely to forget the cyclone

Amreli Chamber of Commerce ...ident Jakubhai Dalal put the ...industries at over Rs one ... industrial sheds ... severely dam-

fected. About two km of railway track has been completly washed away and more than half of all trees in the district have been uprooted.

Officials estimated the losses to roads at Rs 77 lakh while ...mages to Government buildings ...r public sector establish- ...ay work out to about ...re.

...ent factory at Jaffrabad jetty constructed near it ...ffered severe damages, ac- to State Finance Minister Mehta who is supervising operations in the area.

...sive damage railways

...ress News Service

BOMBAY, Nov 12

...tre gauge sections of ...ern Railway between ...unction and Khijadiya ...adiya and Visavadar in ...nagar division, have suf- ...ensive damages due to ...nic storm.

...oad gauge trunk routes Surat and Baroda and and Ahmedabad have ...ered extensive damages, y to the overhead equip- ... reports reach-

RAJ... Mon... days ... arat's c... when th... through... by a ... At ... to be ... been ... 52 ... sing... wi... fr... w...

Damage in Saurashtra over Rs 100 crore

Express News Service

RAJKOT, Nov 10

Damage due to cyclone in Saurashtra is estimated to be over Rs 100 crores, according to prelimi- nary reports reaching here. According to experts, the dam... much worst compar... flash floods ... it is

damage caused by the cyclone. The Minister said that Rs 1,000 would be given to the relatives of the deceased and Rs 500 to those injured. The worst hit in Saurashtra were people belonging to the weaker section who got 100 square metres of land and had built houses on this land. Around 5000 such houses have been badly damaged due ... and strong ...

Government has already sanctioned Rs.20 crores as relief advance to the state. Several social organisations and individuals have been distributing utensils, clothes, blankets and foodgrains in the affected areas.

The state announced that fishermen who lost their boats will get a subsidy to the extent Rs.1/3 of the price of a boat upto a maximum of Rs.8,000/-. Those whose boats have been damaged will get a subsidy of 1/3 of the damage with a ceiling of Rs.2,500/-. Higher amounts were given to replace /repair trawlers.

Low interest loans are being provided to rehabilitate cyclone affected industrial units by Gujarat State Finance Corporation and Gujarat Industrial Investment Corporation. The latter has decided to open depots at Veraval, Junagadh and Amreli to supply cement and galvanised iron sheets to the affected units. Government has also decided to defer the recovery of sales tax and electricity tariff from the affected units for one year period. Already about 36 affected units have received loans over Rs.4 lakhs. Under the special scheme, loans of upto Rs.25,000 at 4.5% interest would be granted to the small units affected. The loan requirements between Rs.25,000 and Rs.50,000 carrying an interest of 9% would be financed by the State Finance Corporation. Loans exceeding Rs.50,000 upto 5 lakhs would also be financed to the needy units but at normal rate. Moreover, the State Government has formulated a proposal that Banks should extend loans of upto Rs.50,000 which would be guaranteed by the Government.

Overall effects of Cyclone

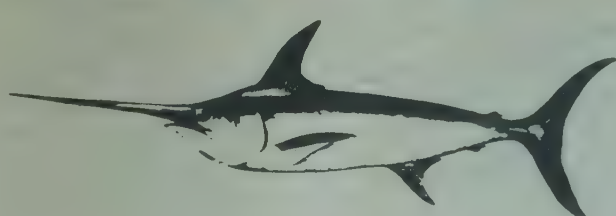
The marine catches of Saurashtra coast comprise mainly Bombay duck,sciaenids, pomfrets, elasmobranchs, clupeoids, seer fish, cat fish, ribbon fish and prawns. For about 15 days immediately after the cyclone, no fish was landed due to suspension of fishing consequent to the cyclone havoc, resulting in an estimated loss of Rs.442 lakhs. The loss due to damages to crafts, gears, fish materials and houses in the fishing villages of Junagadh, Amreli and Diu districts was estimated at Rs.232 lakhs. The fishing industry at Veraval suffered a loss of about Rs.123 lakhs. In addition Rs.9 lakhs were estimated to be the loss due to damages to the boats anchored in the harbour. The damages to the fishing harbour at Veraval were estimated to be about Rs.80 lakhs. The loss at Porbander and Mangrol worked out to Rs.3 lakhs. Thus the total loss to the marine fishery sector due to the cyclone is estimated at Rs.889 lakhs.

About 13,000 fishermen engaged in fishing in Saurashtra coast were rendered jobless for a period of 15 days. Another 1,500 persons engaged in allied activities like transportation of ice and marketing of fish also could not take up any work during the same period. Moreover, these fishermen are not in general benefited by institutional credit agencies. They take advances from traders and sell their catches to them. The traders charge heavy interest through purchasing the fishes at rates much less than the open market price. The fishermen generally repay their loans during the season. But due to the cyclone and the subsequent lay off it was impossible for them to clear off their debts. In addition, these fishermen took advances for repairing their boats and huts damaged, by which their debts are further getting accumulated resulting in their bondage to those traders. This will have social repercussions.

After cyclone it is reported that there was a decrease in catches. This has brought ill-luck not only to the fishermen but also to others involved in fishing industry like merchants, traders and owners of freezing plants. In Saurashtra coast, most of the freezing plants run below capacity but after cyclone this un-utilization further increased and aggravated the unemployment problem.

The boats that got damaged during cyclone period were attended by a heavy influx of carpenters, machanics and other labour force from the mainland. This has accelerated the repair works.

The Government is doing its best to rehabilitate the victims. While the fishing operations are fast reaching normalcy it would take a few more months before the freezing plants and fish meal factories would be able to process fish at the normal level. Inspite of the will and determination on the part of fishermen, fishing industry, government and social organisations, it would take at least another three months to put the system back on the wheels.



TRAWL FISHERY OF SOUTH KANARA WITH SPECIAL REFERENCE TO PRAWNS AND BY-CATCHES*

Introduction

Mechanised trawling for prawns has assumed great significance in recent years due to the increasing demand for prawns from export industry. Prawns are also caught in traditional gears like cast net, kanthabale (bottom set gill net) and kairampani net (shore seine) during monsoon months, but contributing to negligible quantities. Hence, although prawns form less than 15 percent of the trawl catches, the export oriented industry is largely dependent on trawl fishery.

Karnataka contributes around 2.1 percent of the total prawn landings in our country amounting to 3863 t (based on the average for 1971-80).

By way of by-catch large quantities of fishes consisting of both cheap trash fish and quality fishes are landed from shrimp trawling. The total by-catch forms as high as 85 percent of the trawl landings.

Karnataka has got a coast line of 300 km. An appraisal of the trawl fishery is being attempted based on the data collected from Mangalore and Malpe during the fishing seasons 1980-81 and 1981-82.

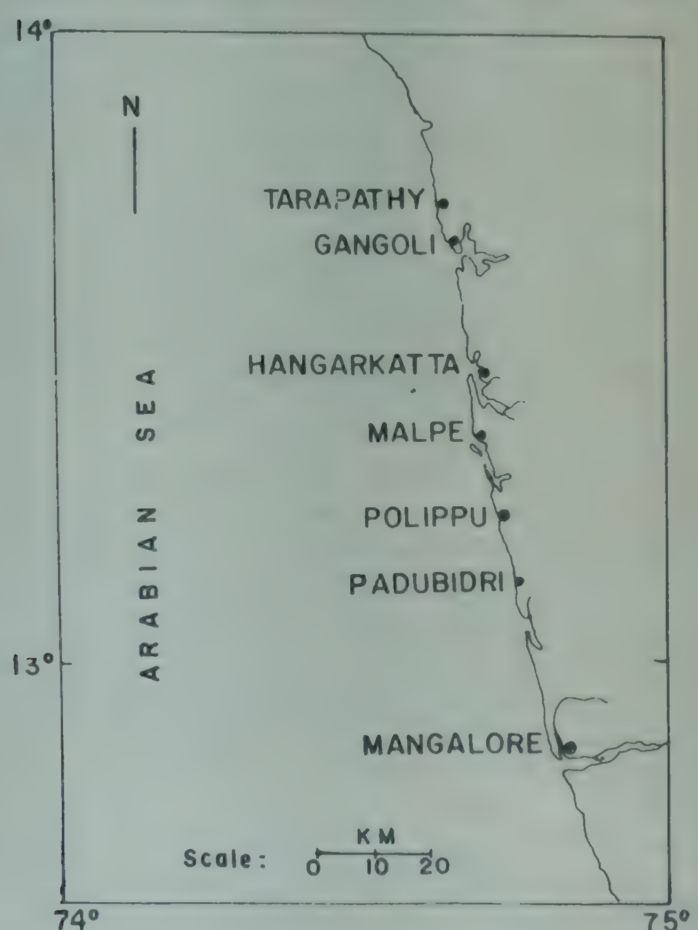


Fig. 1. South Kanara map showing the important trawler landing centres.

Craft and gear

Boats of varying lengths from 6.7 m to 10.97 m fitted with 20 to 96 H.P. engine using otter trawl with head rope length of varying lengths are operated from this area. A few large vessels (13.2 m) fitted with 120 H.P. engine are pressed into service during peak seasons.

Around 1500 trawl units are operating along this coast. Of this, 1161 units are in South Kanara alone, and most of them are centred around Mangalore (425 boats), Malpe (342 boats) and Gangoli (219 boats) mainly due to the infrastructural facilities (storage, transport, market etc.) available there. In addition, some boats are operated from Padubidri (33 units), Polippu (40 units), Hangarkatta (94 units) and Tarapathy (8 units) (Fig.1).

Fishing season

Normally the trawling starts in September after the south west monsoon and lasts till May end or early June. With the onset of monsoon the fishing with mechanised vessels is suspended and the indigenous fishery takes over.

Fishing operations.

Generally the trawl units set out for fishing at dawn and return around mid-day. Sometimes, the landings are continued upto 2-3 p.m. at Mangalore, whereas, at Malpe, this is continued till late in the evening during peak seasons.

The smaller boats (6.7 m to 9.75 m) usually fish in 10-25 m depth. During January to April, the larger boats go for 1-2 days' night fishing. These units generally operate the net upto a depth of 40 m for catching larger varieties of prawns which are brought to the landing centre in large ice boxes. A few big vessels after 3-4days' fishing bring the catch in their fish-holds in crushed ice.

The number of hauls made by each unit vary from 1 to 1-3 per day with an average of 2 hauls, each lasting normally 2-3 hours.

Fishing grounds lie within 15 km from the shore.

*Prepared by K.K.Sukumaran, K.Y.Telang and O.Thippeswamy.

Table.1. *Estimated month wise landings (in tonnes) of the important groups by trawl nets at Mangalore during 1980-81 & 1981-82.*

Categories	September		October		November		December		January	
	80-81	81-82	80-81	81-82	80-81	81-82	80-81	81-82	80-81	81-82
Prawns	79.7	8.4	0.2	0.3	2.2	120.2	78.6	152.9	127.9	61.2
Fishes	27.8	20.0	—	1.5	31.2	677.9	263.8	377.0	241.3	271.7
Stomatopods	—	—	—	—	9.5	147.3	383.8	326.1	441.2	362.2
Crabs	—	—	—	—	—	0.2	21.3	8.7	20.5	14.5
Cephalopods	—	—	—	—	0.8	3.8	1.8	14.2	1.4	5.2
Total	107.5	28.4	0.2	1.8	43.7	949.4	749.3	878.9	832.3	714.8

Categories	February		March		April		May		June		Grand Total	
	80-81	81-82	80-81	81-82	80-81	81-82	80-81	81-82	80-81	81-82	80-81	81-82
Prawns	89.6	140.1	47.7	168.2	117.0	148.7	132.8	183.7	—	0.9	675.7	984.6
Fishes	456.0	326.8	334.6	954.4	617.3	546.3	528.2	898.7	—	11.9	2500.2	4086.2
Stomatopods	500.2	272.2	163.5	627.3	220.3	758.2	168.7	80.8	—	4.2	1887.2	2578.3
Crabs	31.4	19.0	19.8	24.2	26.5	20.1	28.5	7.8	—	0.4	148.0	94.9
Cephalopods	3.3	2.6	1.6	21.7	0.8	7.8	0.9	5.2	—	0.1	10.6	60.6
Total	1080.5	760.7	567.2	1795.8	981.9	1481.1	859.1	1176.2	—	17.5	5221.7	7804.6

Catch and catch composition

The annual landings at Mangalore was estimated at 5221.7 t (196.7 kg/boat day) and 7804 t (228.2 kg/boat day) during 1980-81, 1981-82 respectively. At Malpe, it was 5256.0 t (212.1 kg/boat day) during 1981-82 (Table 1 and 2). Though the trawling season is spread from September to May, the bulk of the catch was realised during the latter half January-May. The landings, generally low during October-November, increased to a peak during February-March and thereafter, declined marginally during the following months (Fig.2).

The trawls being primarily operated for prawns, the catches could be broadly grouped into prawns and by-catches, including 1) fishes 2) stomatopods 3) crabs and 4) cephalopods.

On an average, around 50% of the catch was contributed by fishes, 13% by prawns, 34.5 % by stomatopods, 2% by crabs and the rest by cephalopods (0.5%) (Fig.3).

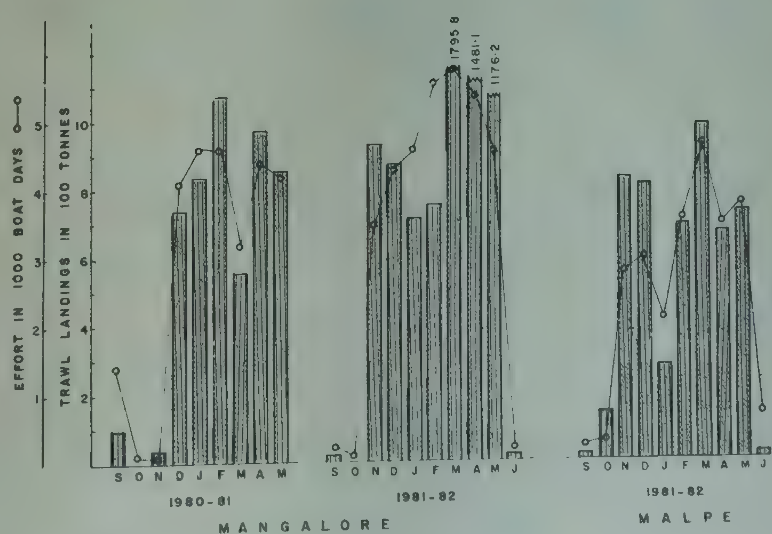


Fig. 2. Monthwise trawl landings and effort in boat days during 1980-81 and 1981-82 at Mangalore and during 1981-82 at Malpe.

Table.2. *Estimated monthwise landings (in tonnes) of the important groups by trawl nets at Malpe during 1981–82*

Categories	September	October	November	December	January	February	March	April	May	June	Grand total
Prawns	9.2	0.2	150.6	87.7	21.2	79.8	69.6	98.6	46.9	5.3	569.4
Fishes	9.5	135.3	379.8	235.3	123.4	314.9	403.0	375.8	676.9	18.9	2672.8
Stomatopods	—	—	313.3	475.4	118.0	249.8	505.4	189.9	15.0	2.1	1868.9
Crabs	—	—	1.4	0.3	16.6	54.0	10.5	11.6	9.4	0.8	104.6
Cephalopods	—	—	1.1	20.0	3.2	1.8	12.0	2.2	—	—	40.3
Total	18.7	135.5	846.2	818.7	282.4	700.3	1000.5	678.4	748.2	27.1	5256.0

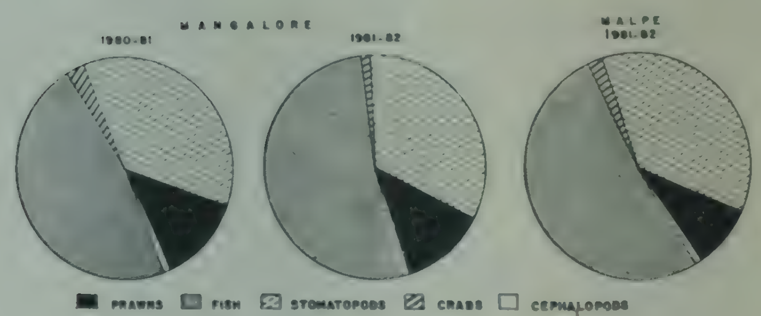


Fig. 3. Distribution pattern of the major categories in the shrimp trawlers at Mangalore (1980 81 & 1981-82) and Malpe (1981-82).

Prawns

The prawns are represented by *Metapenaeus dobsoni, M.affinis M.monoceros, Parapenaeopsis stylifera, Penaeus indicus* and *P.monodon*. Among them, *P.stylifera* and *M.dobsoni* were the dominant species contributing around 80–85% of the annual prawn catch (Fig.4). The estimated landing of prawns was 675.7 t and 984.6 t respectively during the two seasons at Mangalore. At Malpe, it was 569.4 t during 1981–82.

It may be seen that generally October–November is the lean period for prawns. The landings were fairly high during the latter half of the season particularly during May at Mangalore and during November at Malpe (Fig.5).

M.dobsoni, locally known as 'Poovalan', formed 53.5% of the prawn catch (361.4 t) during 1980–81 at Mangalore. In the following season, the landings decreased by 19.3% and accounted for only 29.6% (291.5 t) at the same centre. At Malpe, it contributed 20.5% (116.0 t). Landings were generally high

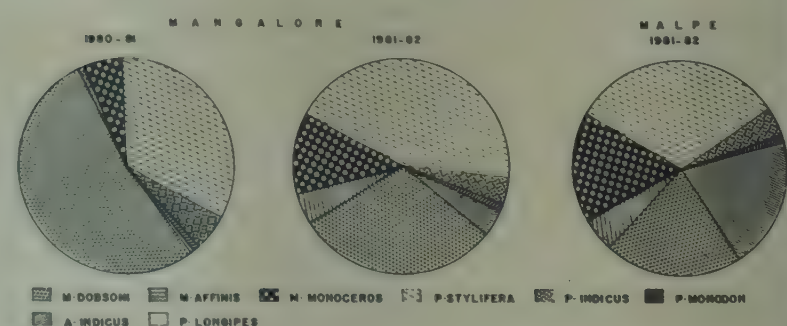


Fig. 4. Species composition of prawns landed by shrimp trawlers at Mangalore (1980–81 &1981–82) and Malpe (1981–82)

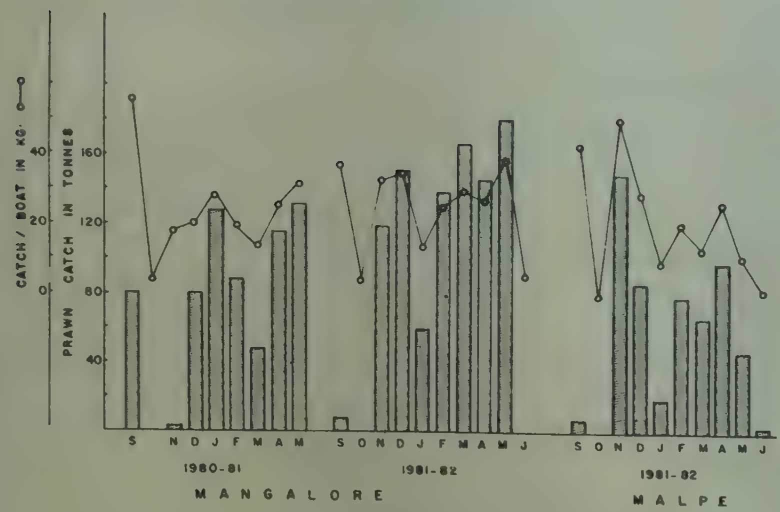


Fig. 5. Monthwise prawn catch and catch rate during 1980-81 and 1981-82 at Malpe.

during September and January- May at both the centres.

The catches of *M.affinis* (brown shrimp) were very poor during 1980-81 forming 0.9% of the annual prawn catch (6.3 t) at Mangalore. However, in the following season, the catches were better and amounted to 46.2 t (4.7 %). At Malpe, it formed 5.2% (29.6 t). The best catches were obtained during February at both the centres.

M.monoceros, also known as brown shrimp, contributed to 5.9% of the annual prawn catch (40.2 t) during 1980-81 at Mangalore. The landings improved considerably during the following season forming 12.2 % (120.3 t). It formed 16.7% (94.5 t) at Malpe. Landings were fairly good during March at Mangalore and in December at Malpe.

P.stylifera, locally known as 'karikadi', contributed to 33.3% during 1980-81 (225.3 t) at Mangalore. The catches improved in the following year and formed 44.2% (434.9 t). It contributed to 32.0% (181.7 t) at Malpe during 1981-82. The catches were generally high during April-May at both the centres.

The catches of *P.indicus* (white shrimp) was 35.2 t (5.2%) and 49.3 t (4.1%) respectively during the two seasons at Mangalore. At Malpe, it formed 4.3% (24.6 t). March-May seems to be the best season for this prawn.

P.monodon (Tiger shrimp) is very important from the commercial point of view as it grows to very large size. However, it formed only 1 % or less of the annual average landings at Mangalore and Malpe. The catches amounted to 4.6 t and 9.2 t respectively during the two seasons at Mangalore and, it was 4.6 t at Malpe.

Parapenaeus longipes, although growing to comparatively smaller size, is potential resource occuring during April-May and the annual catch was 2.7 t during 1980-81 at Mangalore.

Acetes indicus was seldom caught in trawl nets in large quantities. The landings were fairly high during November 1981 forming 4.3 % of the annual average prawn catch (42.2 t) at Mangalore and, 20.5% (116.2 t) at Malpe.

By-catches

Fishes

Fishes, contributing to about 50% of the trawl catches, are represented by a number of groups of species. Their abundance vary from season to season and month to month. Fig.6 shows the percentage composition of the important fish groups during 1981-82 at Mangalore and Malpe.

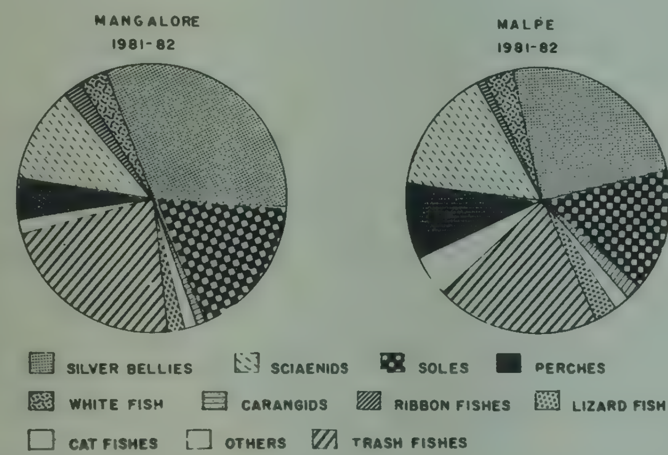


Fig. 6 Distribution pattern of the important category of fishes during 1980-81 and 1981-82 at Mangalore and 1981-82 at Malpe (Others - includes all those variety of fishes which contributed less than 1 percent.

Silver bellies, are the dominant group among fishes, contributing to 31.2% and 24.5% at Mangalore and Malpe respectively during 1981-82. Though a number of species of *Leiognathus* and a single species of *Gazza* occur regularly in trawl catch, *Gazza minuta, Leiognathus splendens, L.bindus* and *Secutor insidiator* are the abundant species, maximum catch was recorded during September- October.

Sciaenids, popularly known as 'Jew fishes', are generally caught in shrimp trawls throughout the year in varying quantities. In the annual fish catch, it formed 11.6% and 15.1% respectively at Mangalore and Malpe during 1981-82. Though this group is represented by several species, *Otolithoides cuvieri* together with a few species of the genus *Johnius* formed the bulk of the sciaenid catch.

Soles occurred round the year and contributed 17.5% and 15.0% respectively at Mangalore and Malpe. This group is mainly represented by a single species *Cynoglossus semifaciatus* and mostly consisted of smaller sizes 8–12 cm.

Perches formed 5.0% at Mangalore and 8.6% at Malpe during 1981–82. *Nemipterus japonicus* contributed to the bulk of the catch. Maximum catch was recorded during May.

White fish *Lactarius lactarius* is one of the quality fishes caught in small quantities round the year. It formed 3.2% and 3.8% respectively at these centres. The size ranging from 7 to 18 cm generally supported the fishery.

Carangids occur throughout the year and formed 1.2% and 2.0% respectively at these centres. It is represented by several species of *Caranx* and allied forms. Of these, *Selar calla* is the chief species contributing to around 80–90% of the carangid catch.

Ribbon fishes, represented by two species *Trichiurus lepturus* and *T.savala*, formed 2.1% respectively at Mangalore and Malpe. Bulk of the catch was obtained during April–May and September - October.

Lizard fish *Saurida tumbil* formed 1.9% and 3.0% respectively at these centre. Catches were fairly good during March–May.

Cat fishes occured fairly in good quantities during March–May and contributed to 1.4% and 1.8% respectively at Mangalore and Malpe. *Arius tenuispinus* (size ranging from 15 to 35 cm) was the abundant species.

Among fishes, pomfrets are more in demand and hence highly priced. It occured as stray numbers and formed less than 1 percent. It is represented by *Apolectus niger* (black pomfret) and *Pampus argenteus* (silver pomfret).

Anchovies are caught in small quantities during April–May and contributed less than 1 percent. *Stolephorus battaviensis* was the most common species.

Elasmobranchs (sharks, rays and skates) and clupieds *(Anadontostoma chacunda, Dussumieria acuta, Hilsa ilisha* and *Sardinella longiceps)* occur in stray numbers regularly.

In addition, several species of trash fishes of demersal and mid–pelagic nature, are landed in large quantities round the year and formed 22.6% and 20.0% respectively at Mangalore and Malpe.

Stomatopods

This group is represented by a single species, *Oratosquilla nepa*. The catches amounted to 1887.2 t and 2578.3 t during 1980–81 and 1981–82 respectively forming 36.1% and 33.0% of the annual trawl landings at Mangalore. At Malpe, the catch was to the tune of 1868.9 t forming 35.5% during 1981–82. The landings were very high during February–April.

Crabs

Though this group is represented by a number of species along this coast, *Portunus sanguinolentus* and *P.pelagicus* are only commercially important. These species together formed around 2% of the annual average catch by trawls. The estimated landings amounted to 148.0 t (1980–81) and 94.9 t (1981–82). At Malpe, it was 104.6 t during 1981–82. Landings were generally good during February–March at both the centres.

Cephalopods

Squids *(Loligo duvacelli)* and cuttle fish *(Sepia aculeata, Sepiella inermis* and *Sepia pharaonis)* represent this group in the order of their abundance. Cephalopods contributed less than 1% in the annual trawl landings at both the centres. The annual catch was 10.6 t and 60.6 t at Mangalore and 40.3 t at Malpe. Better catches were obtained during December–March.

Marketing and disposal.

To facilitate auctioning, different category of prawns, quality fishes, crabs etc. are sorted out on board before arriving at the landing site. The catches, immediately on arrival, are taken out for disposal. If the boats are financed by Government agencies, auctioning is conducted by South Kananra Co–operative Fish Marketing Federation and 50% of the amount realised is adjusted towards the repayment of the loan, provided the prawn catches are heavy. Instead, if the prawn catches are low, only 5% of the return is taken as commission by Federation. Auctioning is generally done to fix the price of prawns (per kg) landed by different boats, separately. This is done since the quality and size of prawns vary from boat to boat. Even the rates of a single species differ from boat to boat in a day. The monthly average auctioning rates for different category of prawns are presented in Table 3. It is seen that the rate ranged from Rs.5 to 14 for *P.stylifera*, and from Rs.17 to 71 in the case of *P.indicus/P.monodon*.

Table.3. *The average auctioning rates (in Rupees) of different category of prawns at Mangalore during 1980-81 and 1981-82*

		M.dobsoni	*M.affinis*	*M.monoceros*	*P.stylifera*	*P.indicus*	*P.monodon*
September	1980-81	10.96	—	—	—	36.94	—
	'81-82	16.00	—	—	—	—	—
October	'80-81	—	—	—	—	—	—
	'81-82	—	—	—	—	—	—
November	'80-81	—	—	—	—	—	—
	'81-82	13.55	27.70	27.70	13.30	32.50	42.50
December	'80-81	10.90	—	—	11.80	17.00	—
	'81-82	11.75	28.75	28.75	10.75	37.00	45.60
January	'80-81	12.10	23.00	23.00	10.60	25.00	—
	'81-82	13.00	28.00	28.00	11.00	40.00	55.00
February	'80-81	14.20	29.00	18.80	12.80	39.45	48.35
	'81-82	16.00	29.00	29.00	14.00	42.00	58.00
March	'80-81	13.20	25.50	26.45	12.65	39.80	44.50
	'81-82	13.00	26.00	26.00	10.50	43.00	55.00
April	'80-81	14.35	25.00	26.40	12.95	40.00	—
	'81-82	13.50	30.00	30.75	10.25	57.75	—
May	'80-81	12.00	—	—	5.00	38.00	—
	'81-82	16.40	38.00	—	10.00	71.00	—
June	'80-81	—	—	—	—	—	—
	'81-82	16.50	—	—	9.40	—	—

In addition, there are a good number of boats owned by private parties (In Mangalore, more than 100 units are private and at Malpe, except a few, all the boats are owned by private agencies). Prawn catches of these units are booked by agents by financing huge sums. Normally, they take the prawn catch at a reduced rate. Later, the prawns are sold to local freezing plants at higher prices by some agents, while others send them to Cochin by train in crushed ice in bamboo baskets reinforced on sides by coconut leaves/mats made of palmyra leaves.

Crabs and quality fishes are auctioned by Federation/fishermen in the landing centre itself immediately on arrival. Generally a few baskets are taken out and auctioned as a lot. These fishes /crabs are purchased by fisherwomen/merchants /cycle venders etc., who in turn take them to the nearby markets or transport them in crushed ice to interior markets for immediate consumption. If the catches are heavy, some of the fishes like silver bellies, soles, *Lactarius*, carangids, cat fish, anchovies etc., are salted and dried/sun dried for future sale.

The stomtopods are purchased by agents who supply them to fish meal plants nearby. At Malpe, this is sundried and packed in gunny bags before selling them to fish meal plants/as manure at a premium.

Similarly, cephalopods are purchased by agents directly from the boats and supplied to processing units.

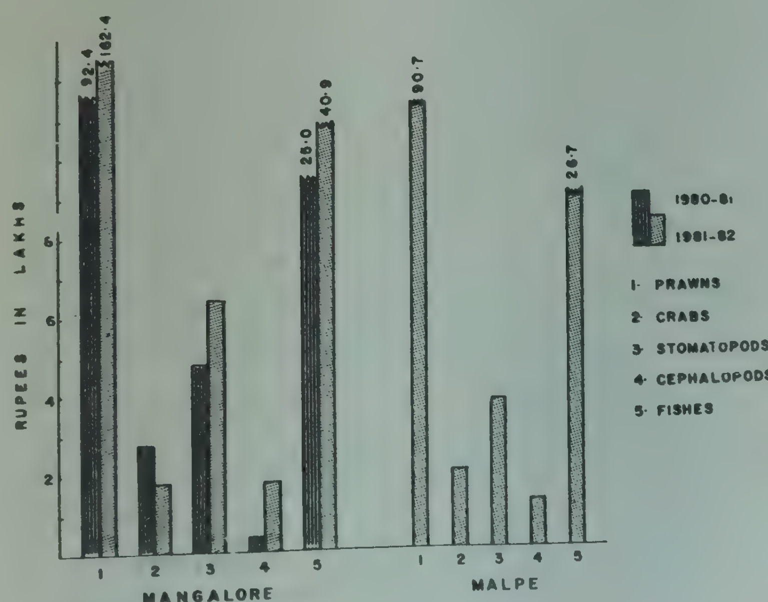


Fig. 7. Value of the major categories lnded by shrimp trawlers during 1980-81 & 1981-82 at Mangalore and 1981-82 at Malpe.

Based on the average price, the total estimated value realised in rupees was 12.5 million during 1980-81 at Mangalore. During 1981-82, the total amount realised was 21.3 million which was 70.3% more than that obtained during the previous season (Fig.7). This was due to enhanced catches of prawns and other fish groups resulting in better returns. At Malpe, the total value realised was 12.4 million rupees. In the total value, prawns alone contributed upto 75% at Mangalore and 72.3% at Malpe. The next important group was fishes fetching around 20% of the total value followed by stomatopods, crabs and cephalopods.

General Remarks

It is interesting to note that prawns alone contributed around 70-75% of the total value realised, although it formed only 13% of the annual average trawl catch. Due to the ever-increasing demand for prawns from the processing industry, there has been a tendency to increase the number of trawl units since the beginning of seventies resulting in a two-fold increse in fishing effort within a decade. The heavy exploitation of prawn resources is continuing and although there has not been any serious depletion of the resources, considerable strain on the exploited stock is evident, resulting in wide fluctuations in the catches. However, prawns being an annual stock, it may be possible for the resource to recover by the strength of the new recruits every year despite heavy fishing. The breeding migration of females of prawns, annual forced closure of the fishing during the period of the south west monsoon and the limited period of the fishing season (December-May) together with the restricted operations of trawls within 40 m depth are some of the biological and fishery controlled factors favourable for the resources to replenish its stock. In view of all these, although there has been fluctuation of the catches, showing very low returns in some years, it may not lead to any serious depletion of the resources, atleast in the near future, necessitating any urgent conservatory measures. However, a close monitoring of the situation is essential.

INDUCED SPAWNING AND LARVAL REARING OF *CRASSOSTREA MADRASENSIS* (PRESTON) IN THE LABORATORY*

The technology of culturing the edible oyster *Crassostrea madrasensis* by rack-and-tray method has been developed by the Central Marine Fisheries Research Institute at Tuticorin. For carrying out oyster culture more effectively it is necessary that hatchery techniques are evolved so that oyster seed could be adequately produced and supplied for a continuous culture system.

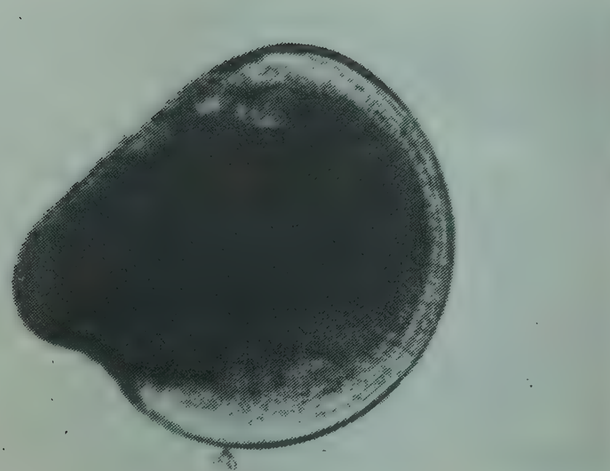
Investigations on induced spawning and rearing of the oyster have been taken up at the Institute's hatchery laboratory at Tuticorin. For the first time in India spat of *Crassostrea madrasensis* have been produced on a large scale in August, 1982 in the laboratory.

Spawning: Oysters selected for spawning are conditioned for 24 to 48 hours at temperatures of 20°C to 22°C in an air-conditioned room. During this period the oysters are fed with phytoplankters (a mixed culture of diatoms and *Chlorella).* The oysters are then transferred to water at temperature above ambient level i.e., 30°C-32°C. When so treated the oysters usually spawn. To ensure spawning in females, sperm suspension from a ripe male is provided in the medium as an additional stimulus. The spawning process is generally over within 5 to 20 minutes which depends on the condition of the gonad. The gametes are transferred to a 10-1 beaker containing seawater specially filtered through cartridges. The fertilised eggs settle at the bottom and undergo further development.

Larval rearing: The first cleavage of the egg follows immediately after the appearance of the second polar body and successive divisions occur quickly. At the end of 3½ hours the morula stage is

*Prepared by K.Nagappan Nayar, M.E.Rajapandian, A.Deivendra Gandhi and C.P.Gopinathan.

A



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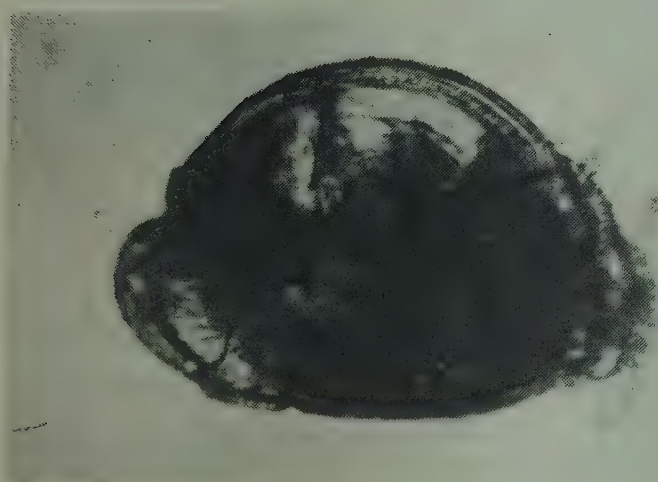
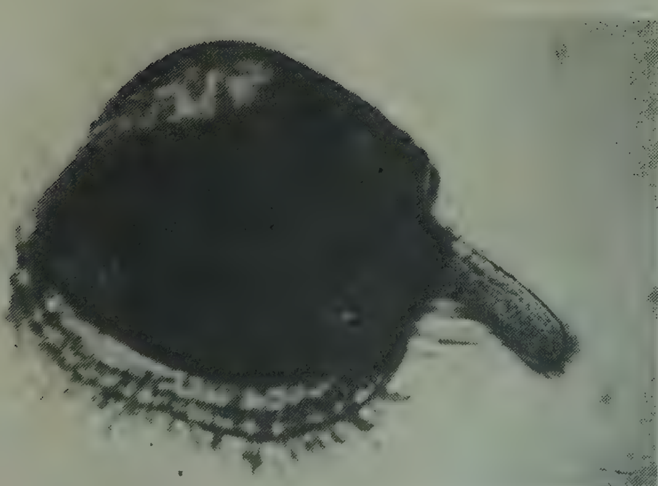


Fig. 1. Larval stages and spat of edible oyster *Crassostrea madrasensis* A.Stright-hinge stage. B.Umbone stage. C.Eyed stage. D.Pediveliger stage. E.Spat.

D



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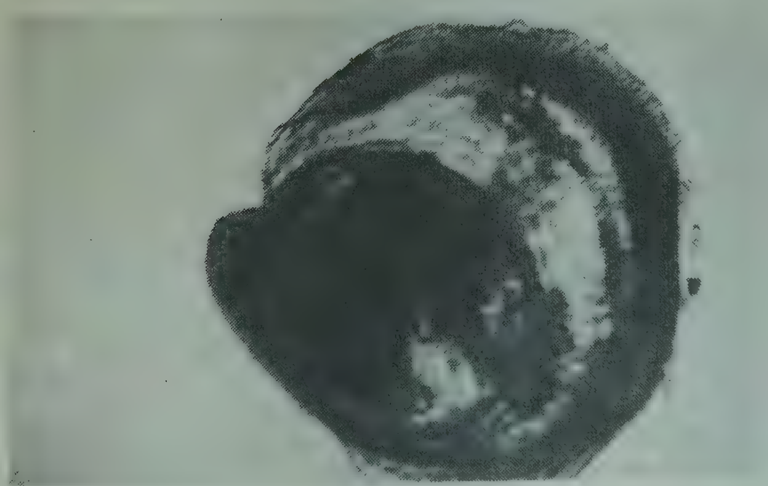

reached. After further development, the straight--hinge or 'D' shell larval stage is reached at the end of 20 hours (Fig.1A). The larva is semi-transparent with the velum creating a strong ciliary current which directs minute particles of food into the stomodaeum. On an average the larva measures 50 μ along DVM (dorsoventral measurement) and 66 μ along APM (anteroposterior measurement) on the first day. On the 3rd day the larva becomes slightly oval in shape and measures 95 u along DVM and 100 μ along APM. On the 7th day the larva attains the umbone stage and measures more along DVM than APM and the shell grows by addition of ridges. The larva measures on an average 150 μ along DVM and 110 μ along APM at this stage (Fig.1B).

The larva attains eyed stage on the 17th day. The foot is slightly developed with a tuft of cilia at the tip (Fig.1C). The larva measures between 295 μ and 310 μ along DVM and between 250 μ and 275 μ along APM. On the 18th day the larva starts crawling with the foot and becomes pediveliger (Fig.1D). The larva measures 350 μ along DVM and 310 μ along APM. Subsequently the pediveligers settle to lead a sessile life. The velum totally disappears and the labial palps and gills start appearing. This is known as plantigrade stage. Thereafter the larvae develop the characteristic adult features and metamorphose into spat (Fig.1E). The young spat measures 450 μ along DVM. On the whole, the development is completed within 19 days after fertilisation.

The larvae from straight-hinge stage were fed with *Isochrysis galbana* cultured in the laboratory under controlled temperature. Further work is in progress to standardise methods for producing oyster spat on a large scale.

DESTRUCTION OF EGGS OF CATFISH, *TACHYSURUS TENUISPINIS* BY PURSE SEINERS AT KARWAR*

The unwarranted destruction of huge quantities of eggs of catfish, *Tachysurus tenuispinis* by purse seiners in 1980 at Mangalore, Malpe and Gangoli of Dakshina Kannada District of Karnataka and its grave consequences was highlighted earlier in these columns (Mar. Fish. Infor. Serv. T&E Ser.,24 1980). In view of this, it was expected that due care would be exercised in the fishery by purse seiners, especially during September and October which happens to be the spawning season for *T.tenuispinis*. But this year also the same catastrophe is being repeated. There seems to be no regulation on the purse seine fleet operating in Uttar Kannada region in order to avoid indiscriminate fishing.

During September 1982 these seiners operating from Karwar landed catfish *T.tenuispinis* along with eggs in large quantities. The eggs landed amounted to 3.9 tonnes between 23rd and 29th September and again weighing 2.3 tonnes from 8th to 21st October. The catch details are given below:

Date			Catch of *T.tenuispinis* Adults (kg)	Eggs *(kg)*
22nd	September	1982	200	—
23rd	"	"	4,000	175
24th	"	"	3,500	120
25th	"	"	9,000	775
26th	"	"	61,000	2,050
27th	"	"	5,000	175
29th	"	"	14,000	575
30th	"	"	14,000	-—
8th	October	"	2,000	225
9th	"	"	1,000	110
10th	"	"	7,100	525
11th	"	"	7,200	550
14th	"	"	100	15
21st	"	"	8,000	850
Total			1,36,100	6,145

These fishes were caught in the region 45-50 km north and south, almost equidistant from

*Prepared by M.H.Dhulkhed, S.Hanumantharaya and N.Channappa Gowda.

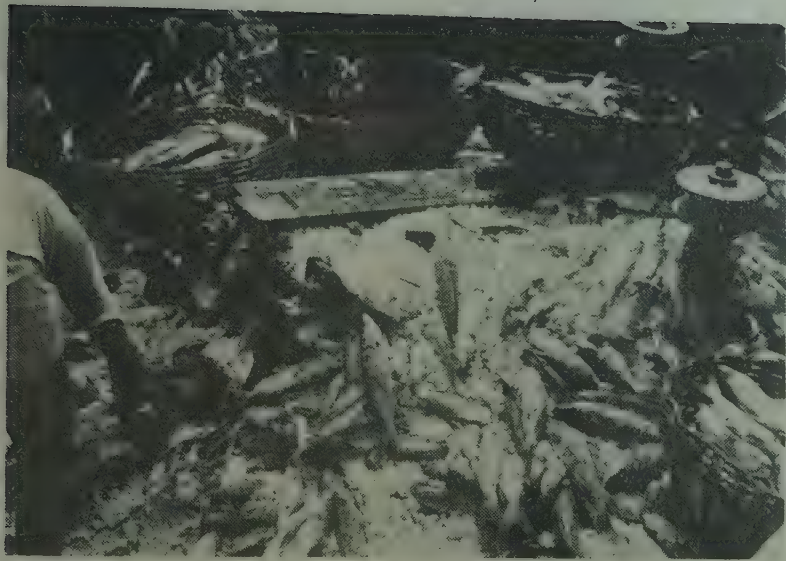

Fig. 1. Catch of catfish *T.tenuispinis* with incubating eggs landed by purse seiner at Karwar.

Fig. 2. Eggs of *T.tenuispinis* in baskets for disposal.

Karwar in the depth range of 20-30 m. The total length ranged from 210 mm to 390 mm with modes at 310 mm, 330 mm and 350 mm, about 3,000 nos weighing 1 tonne (Fig.1). The price varied from Rs.22 to Rs.50 per 100 nos. The fishermen had better financial returns initially. Later the prices slumped because of catch of other fishes. As there is a limited local market for consumption in fresh condition, practically all the catches were packed in ice and transported by lorries to Mangalore and further south. Some found their way to Bombay markets also.

Almost all the catch consisted of males, most of them carrying eggs in their mouth. The maximum number of eggs counted in the mouth of a single fish was as high as 46, with diameter varying from 10 to 12 mm. The estimated catch of eggs amounted to 4.5% of the total catch of *T.tenuispinis*. It is likely that large quantities of eggs must have escaped through the meshes of the seines during the operations. It was the first time that eggs in mouth incubating condition in such huge quantities were landed at Karwar (Fig.2). There being no demand for these eggs, their disposal posed a problem and this was solved easily by discarding them either on the wharf or dumping them into the Baithkal cove.

It was estimated that 4.3 million eggs were destroyed in this process, and the enormity of the destruction to the resource could very well be imagined. In view of this, it is felt that the indiscriminate fishing of these catfishes with incubating eggs should be curbed without any further delay, in order to save the resource from complete depletion. Steps may have to be taken on priority basis in educating the fishermen about the adverse effects this sort of indiscriminate destruction of mature fishes and incubating eggs might have on the resource.

SCIENTIFIC, COMMON AND LOCAL NAMES OF COMMERCIALLY IMPORTANT MARINE FISHES AND SHELL FISHES OF MAHARASHTRA AND GUJARAT COASTS*

Very often many fishery entrepreneurs and workers seek information on the scientific, popular and local names of commercially important fishes in the different regions in connection with their trade or studies. Kulkarni *(Jour. Bomb. Nat. Hist. Soc. 51, 1953)* gave an account of these names of fishes of Maharashtra and Gujarat rigion. Since then, with the advent of mechanisation of crafts and gear, the fishing operations have extended to deeper and distant waters which have added many species of fishes to those already recorded. This has necessitated preparation of a fresh account incorporating the latest scientific names and widely used popular and local names of fishes, crustaceans and molluscs commonly occurring in the Maharashtra and Gujarat regions. It is felt that the present account would meet the long felt need and fill up the gaps in the information available to the industry. The scientific names of fishes are mostly as given in F.A.O. identification sheets (1974). The species listed below are given in the alphabetical order, under 28 major groups. The author is greatly thankful to all his colleagues at the Bombay Research Centre for their co-operation in preparing this list. He is also deeply thankful to the Director, CMFR Institute, Cochin for his encouragement, valuable suggestions and guidance in the preparation of this article.

	GROUP	SL. NO.	SCIENTIFIC *NAME*	POPULAR NAME	LOCAL NAME/NAMES MARATHI	GUJARATI
I	ELASMO—BRANCHS a.Sharks	1.	*Chiloscyllium indicum*	Ridge-back cat-shark	Mushi	Musia
		2.	*Carcharhinus melanopterus*	Black finned shark/ Black tip shark	Mori	Mossikhada
		3.	*Galeocerdo cuvieri*	Tiger-shark	Waghbeer	Pattari
		4.	*Rhincodon typus*	Whale-shark	Massa	Barrel
		5.	*Scoliodon laticaudus*	Sharp nosed shark/ Yellow dog-shark	Sonmushi	Sandho
		6.	*Rhizoprionodon acutus*	Grey dog-shark	Balda/Pisori	Pisori
		7.	*Sphyrna zygaena*	Round-headed hammer head shark	Kan mushi/ Kaner/Kaneri	Kan moosi/ Kaner
		8.	*Stegostoma fasciatum*	Zebra shark	Mushi/shinavale	Musia
	b.Skates	9.	*Anoxypristis cuspidata*	Pointed saw-fish	Nali/Win	Chhurio/veher
		10.	*Rhynchobatus djiddensis*	Guitar fish/white spotted shovelnose ray	Ranja/Lanj/Pok	Bhuther/ Dhons
		11.	*Rhinobatus granulatus*	Granulated shovel—nose ray	-do-	-do-
	c.Rays	12.	*Aetobatus narinari*	Spotted eagle ray	Wagali	Wagaliu
		13.	*Aetomylaeus maculatus*	Bat ray	Bolad	Wagaliu
		14.	*Himantura uarnak*	Marbled sting ray	Whaghya pakat	Tarabla/Boor/ Warkhol Patari
		15.	*Himantura bleekeri*	Whip-tail sting ray	-do-	-do-
		16.	*Mobula diabolus*	Devil ray	Karaj	Warala/ Waraloo

*Prepared by J.P.Karbhari

II	EELS	17.	*Congresox talabonoides*	Common eel/Indian pike-conger	Wam	Wam
		18.	*Gymnothorax pseudothyrsoidea*	Black eel	Kilis	Kalas/Naro
III	CATFISHES	19.	*Batrachocephalus mino*	Frog headed cat fish	Shingala	Khagadi
		20.	*Tachysurus sona*	Dusky catfish	Shingala	Khaga/Shingada
		21.	*Tachysurus jella*	Small eye catfish	Shingala	Dharawa
		22.	*Tachysurus dussumieri*	Marine catfish	Shingati	Shingati
IV	CLUPEOIDS					
	a.Wolf Herring	23.	*Chirocentrus dorab*	Silver bar/Dorab wolf-herring	Datali/Karli	Dai/Lapadi
	b.Oil Sardine	24.	*Sardinella longiceps*	Indian oil sardine	Tarali/Haid/Kanat	Tarali
	c.Other Sardines	25.	*Sardinella fimbriata*	Fringe-Scale sardine	Pedwa	Pedvi·
	d.Hilsa shad	26.	*Hilsa ilisha*	Indian shad/ Hilsa shad	Palla/Pala	Chakshi/ Chaski
	e.Other shads	27.	*Hilsa toli*	Giant herring/ Toli shad	Bhing	Modar/Palwa
	f.Anchovies	28.	*Coilia dussumieri*	Golden anchovy	Mandeli	Mandeli
		29.	*Stolephorus bataviensis*	Batavian anchovy/ White bait	Katali	Phansti
		30.	*Thryssa mystax*	Mustached anchovy/ Mustached thryssa	Kati	Palli
		31.	*Thryssa malabarica*	Malabar anchovy/ Malabar thryssa	Kati	Palli
	g.Other Clupeoids	32.	*Escualosa thoracata*	White sardine	Bhiljee	Motwa/Bhanjee
		33.	*Ilisha elongata*	Slender Shad/ Elongate ilisha	Katali/Kati	Phansti/Palee
		34.	*Ilisha megaloptera*	Jewelled shad/ Bigeye ilisha	Kati	Kati/Paturdo
		35.	*Opisthopterus tardoore*	Long-finned herring/Tardoore	Kati	Kati
		36.	*Pellona ditchela*	Indian pellona	Kati	Kati
V	BOMBAY DUCK	37.	*Harpodon nehereus*	Bombay duck	Bombil	Bumla/Gulchi
VI	LIZARD FISHES	38.	*Saurida tumbil*	Greater Lizard/ -fish	Chor Bombil	Chor Bumla
VII	HALF BEAKS & FULL BEAKS	39.	*Rhynchorhamphus georgii*	Half beak gar fish	Sumb/Tol	Toli/Kagada/ Kunga
		40.	*Strongylura strongylura*	Full beak gar fish	-do-	-do-
VIII	FLYING FISHES	41.	*Cypselurus comatus*	Flying fish	Kathala	Jira
		42	*Exocoetus volitans*	Two winged flying fish	-do-	-do-
IX	PERCHES					
	a.Rock Cods (Groupers)	43.	*Epinephelus tauvina*	Greasy grouper	Hekru/Gobra	Wekhru/ Wekhali
		44.	*Epinephelus malabaricus*	Speckled grouper	-do-	-do-
		45.	*Epinephelus fario*	Spotted grouper	-do-	-do-

		46.	*Promicrops lanceolatus*	Giant grouper	-do-	-do-
	b.Snappers	47.	*Lutianus johni*	Snapper	Chavari tamb	Gurka tamb
		48.	*Lutianus argentimaculatus*	Red snapper	Tambusa	Ratado
	c.Pig-face Breams (Emperors)	49.	*Lethrinus frenatus*	Bridled pig-face bream	Dhamil	Dhamil/ Chuncha
	d.Threadfin breams	50.	*Nemipterus japonicus*	Japanese threadfin bream	Rani/Bamni	Rani
	e.Other Perches	51.	*Argyrops spinifer*	Long-spined red bream	Kishi/Lal Kishi	Kishi/Chayo
		52.	*Drepane punctata*	Moon-fish/Spotted bat-fish	Chand	Chand
		53.	*Ephippus orbis*	Spade fish	Vada	Vada
		54.	*Lates calcarifer*	Cock-up/Giant sea perch	Fitadar/Khajura	Bekti/Gariyu
		55.	*Lobotes surinamensis*	Triple tail	Katkola	Katkola
		56.	*Mylio berda*	Black sea bream/ picnic sea bream	Khadak palu/ Kali kishi	Kharapla/ Kali Kishi
		57.	*Pomadasys maculatus*	Spotted grunter	Karkara	Karkara
		58.	*Pomadasys hasta*	Lined silver grunter	Karkara	Karkara
		59.	*Scatophagus argus*	Spotted butter fish	Kaski	Kaski
	Therapon	60.	*Therapon jarbua*	Crescent perch/ Tiger-perch	Naveri hajam	Naida/ Garangeta
X	GOATFISHES	61.	*Upeneus sulphur-eus*	Yellow goat-fish	Chiri/Rana	Chiri
XI	THREADFINS	62.	*Eleutheronema tetradactylum*	Indian Salmon/Four thread tassel fish	Rawas	Rawas
		63.	*Polynemus indicus*	Monk fish/Giant threadfin	Dara/Darha	Dara/Dadha
		64.	*Polynemus heptadactylus*	Seven thread tassel fish	Shende	Shiri
XII	CROAKERS (DRUMS)	65.	*Johnieops sina*	Drab jew fish	Dhoma/Dhomi	Dhoma
		66.	*Johnieops macrorhynus*	Jew fish	Dhoma/Dhomi	Dhoma
		67.	*Johnius dussumieri*	Croaker	Dhoma/Dhomi	Dhoma
		68.	*Johnius vogleri*	Croaker	Dhoma/Dhomi	Dhoma
		69.	*Otolithes cuvieri*	Lesser tiger toothed croaker	Dhoma/Dhomi	Dhoma
		70.	*Otolithoides biauritus*	Dori/Bronze croaker	Koth	Koth
		71.	*Protonibea diacanthus*	Jew-fish/Spotted croaker	Ghol	Ghol
XIII	RIBBONFISHES (HAIRTAILS)	72.	*Lepturacanthus savala*	Sliver ribbon fish/ small headed hairtail	Wagti/Bala	Patti/Ribbon
		73.	*Trichiurus lepturus lepturus*	Grey ribbon fish/ Large headed hair tail	Baga	Baga
XIV	CARANGIDS a.Horse mackerel	74.	*Megalaspis cordyla*	Horse mackerel/ Torpedo trevally/ Hardtail scad	Kati bangada	Khadwo/Kati bangada
	b.Scads	75.	*Decapterus russelli*	Russell's scad	Pilla bangada	Pira bangada
	c.Leather-Jackets (Queenfish)	76.	*Scomberoides lysan*	Port-hole fish/ leather skin	Dagol/Falai	Sug/Chabia

	d.Other Carangids	77.	*Alepes djeddaba*	Djeddaba scad	Kakari bangada	Khadwo bangada
		78.	*Alepes Kalla*	Golden scad	Lalbi-Shitap	Lal bangada
		79.	*Atropus atropus*	Kuweh trevally	Zhat bangada	Khadwo bangada
		80.	*Coryphaena hippurus*	Dolphin-fish	Himra massa	Himra machhi
		81.	*Caranx sexfascia-tus*	Six banded trevally/Dusky jack	Kala bangada	Kala bangada
		82.	*Rachycentron canadus*	Black king-fish	Sakla/Muddus	Modasa
		83.	*Selar crumenopthalmus*	Big-eye scad	Karaba bangada	Karaba bangada
XV	SILVERBELLI-ES (PONY FISHES)	84.	*Leiognathus splendens*	Splendid ponyfish	Katali/Kappi	Katali
XVI	BIG-JAWED JUMPER (FA-LSE TREVA-LLY)	85.	*Lactarius lactarius*	Big-jawed jumper/ False trevally/white fish	Saundala	Dhangari/Katli
XVII	POMFRETS a.Black Pomfret	86.	*Apolectus niger*	Black pomfret	Halwa	Halwa/Adadio
	b.Silver Pomfret	87.	*Pampus argenteus*	Silver pomfret	Saranga/Paplet	Vichuda/Paplet
	c.Chinese Pomfret	88.	*Pampus chinensis*	Chinese pomfret	Kalwad/Kafri	Pathu/Kafri
XVIII	MACKERELS	89.	*Rastrelliger kanagurta*	Indian mackerel	Bangada	Bangada
XIX	SEER FISHES					
	a.Narrow-Bar-red Spanish mackerel	90.	*Scomberomorus commerson*	Barred seer fish	Surmai/Towar/ Anjari	Surmai/Chhapri
	b.Indo-Pacific Spanish mackerel	91.	*Scomberomorus guttatus*	Spotted seer fish	-do-	-do-
	c.Streaked Spanish mackerel	92.	*Scomberomorus lineolatus*	Streaked seer fish	-do-	-do-
XX	TUNNIES					
	a.Little Tuna	93.	*Euthynnus affinis*	Little tuna/Mack—erel tuna	Bugudi/Kuppa/ Gedar	Gedara
	b.Frigate and Bullet Mackerel	94.	*Auxis thazard*	Frigate mackerel	-do-	-do-
	c.Skipjack Tuna	95.	*Katsuwonus Pelamis*	Skipjack tuna/ Striped tuna	-do-	-do-
	d.Other Tunnies	96.	*Thunnus albacares*	Yellow-fin tuna	-do-	-do-
XXI	BILLFISHES	97.	*Istiophorus gladius*	Indian sail fish	Tadmasa	Kunga/ Tadmachhi
		98.	*Xiphias gladius*	Sword fish	-do-	-do-
XXII	BARRACUDA	99.	*Sphyraena jello*	Banded Barracuda/ Sea pike	Badri/Ghalse	Bhungar
XXIII	MULLETS	100.	*Mugil cephalus*	Flathead Grey mullet	Boita/Sherto/ Boi/Pilas	Boi/Bhomat/ Gandhia
		101.	*Valamugil speigleri*	Speiglar's Grey mullet	Mangin/Boir	Mangan/Boi

XXIV	UNICORN COD	102.	*Bregmaceros Macclellendii*	Unicorn cod/ Indian cod	Tenali/Netali	Chirii
XXV	FLATFISHES					
	a.Halibut	103.	*Psettodes erumei*	Indian turbot/ Indian halibut	Zhipali/Bhakas	Hario/Dataro
	b.Flounders	104.	*Pseudorhombus arsius*	Largetooth flounder	Lepti/Lep/ Jeebhti	Jipti/Jeebhti
	c.Soles	105.	*Cynoglossus dubius*	Tongue sole	Gipti/Lep/Shivra	Gipti/Jeebhti
		106.	*Cynoglossus macrostamus*	Malabar tongue sole	Shivra/Lep	Gipti/Jeeb
XXVI	GOBIES AND MUDSKIPPERS	107.	*Awaous stamineus*	Scribbled goby	Kharbi/Nevta	Nevta/Lepta
		108.	*Boleophthalmus dussumieri*	Mud skipper	Nivti	Levti
		109.	*Boleophthalmus boddaerti*	-do-	-do-	-do-
		110.	*Parachoeturichthys ocellatus*	Gobies	Kharbi/Nevta	Nevta/Lepta
XXVII	CRUSTACEANS					
	a.Penaeid Prawns; Littoral species	111.	*Metapenaeus monoceros*	Indian prawn	Chamari/Kapsi	Chamari/Kapsi
		112.	*Metapenaeus affinis*	Indian prawn	Medium Kolabi	Medium Samadi
		113.	*Metapenaeus brevicornis*	Yellow prawn	-do-	-do-
		114.	*Metapenaeus kutchensis*	Kutch prawn	-do-	Kutchii zhinga (Confined to Gujarat only)
		115.	*Parapenaeopsis hardwickii*	Spear prawn	Kolbi	Kolami
		116.	*Parapenaeopsis sculptilis*	Rainbow prawn	-do-	-do-
		117.	*Parapenaeopsis stylifera*	Kiddi prawn	Karkari	Karkari
		118.	*Penaeus indicus*	Indian white prawn	Zinga/Safet	Jimbo
		119.	*Penaeus monodon*	Tiger prawn	Tiger	Tiger
		120.	*Penaeus japonicus*	Kuruma prawn/ Flower	Kuruma kolabi	Kuruma kolami
		121.	*Solenocera crassicornis*	Coastal mud prawn	Goinar	Goinar
	b.Non Penaeid Prawns	122.	*Acetes indicus*	Paste shrimp	Jawala (Kutta)	Jawala (Kuto)
		123.	*Hippolysmata ensirostris*	Hunter shrimp/ pink prawn	Ghobi	Ghobi
		124.	*Palaemon tenuipes*	Shrimp	Ambadi/Kardi	Ambadi/Karadi
		125.	*Palaemon stylifera*	Shrimp	-do-	-do-
	c.Lobsters; Littoral species	126.	*Panulirus polyphagus*	Rock lobster/ Spiny lobster	Shevand	Titan
		127.	*Thenus orientalis*	Sand lobster	Phatphati	Kako
	d.Crabs	128.	*Charybdis cruciata*	Cross crab	Ghodi/Khekhada	Sandaria/ Karachla
		129.	*Portunus pelagicus*	Reticulate crab/ Blue crab	-do-	-do-
		130.	*Portunus sanguinolentus*	Spotted crab	-do-	-do-

		131.	*Scylla serrata*	Stone crab/Giant green crab	Chimbori	Karachli
	e.Stomatopods	132.	*Oratosquilla nepa*	Mantis shrimp	Hijada	Hijara
XXVIII	MOLLUSCS					
	a.Bivalves	133.	*Crassostrea gryphoides*	Edible oyster	Kalaw	Kalu
		134.	*Crassostrea cucullata*	-do-	-do-	-do-
		135.	*Crassostrea discoidea*	-do-	-do-	-do-
		136.	*Meretrix meretrix*	Clams	Shivali/Tigri	Chhipla
		137.	*Paphia malabarica*	-do-	-do-	-do-
		138.	*Tapes spp.*	-do-	-do-	-do
	b.Cephalopods	139.	*Loligo duvauceli*	Squid	Nala/Makul	Narsinga/Ranga
		140.	*Sepia aculeata*	Cuttle fish	Makul/Bahi	Narsinga/Rangara
		141.	*Sepia pharaonis*	-do-	-do-	-do-
		142.	*Sepiella inermis*	Cuttle fish	Makali	Dedaki

NEWS-INDIA AND OVERSEAS

Age determination of shrimp by measuring cellular garbage

Scientists have long sought a foolproof method for determining the age of insects and crustaceans. A possible solution has been reported by an Australian Zoologist, Dr.George Ettershank from Monash University in Melbourne. He has developed a new technique for determining the age of animals as diverse as fleas and shrimps. It involves measuring the level of some fluorescent pigments called *lipofuscins*, which gather in the cells of the animals as a byproduct of metabolic processes. In other words lipofuscins are the "cellular garbage" that collects in the cells of aging animals.

The lipofuscins in an insect or a crustacean tissue could easily be extracted by solvents and measured by a spectrofluorimeter. The level of this would indicate the physiological age of the animal. Thus, according to Dr. Ettershank, whose research was sponsored by the Victorian Economic Development Corporation, an age old problem of insect age determination has been solved by choosing the level of lipofuscins as a metabolic marker. The technique is equally applicable to crustaceans and this would be of far reaching consequence as it would be useful in assessing the stocks and resources of shrimps including the potential krill resources of Antarctica.

Fishing harbour development in Tamil Nadu

Government of Tamil Nadu has approved the construction of a fishing harbour at Chinnamuttam in Kanyakumari district with berthing facilities for 240 mechanised boats and 10 trawlers at a cost of Rs.23.4 million and another at Valinokkam in Ramanathapuram district with landing facilities for 150 mechanised boats costing Rs.7.7 million. These projects are expected to be completed in 1985 and 1983 respectively.

Proposals have also been made to construct a fishing harbour at Pazhayar in Thanjavur district at a cost of Rs.6 million and another at Thondi in Ramanathapuram district at a cost of about Rs.9 million. Plans to acquire more mechanised fishing boats, in view of the possibilities of increasing the exploitation and production from the marine sector, are under consideration.

* * * * * * * *

Compiled and prepared by M.J.George, G.Subbaraju and S.K.Dharmaraja.
Published by Dr.M.J.George, Senior Scientist on behalf of the Director, Central Marine Fisheries Research Institute, Cochin-682 018. Phototypeset and printed at PAICO, Cochin 31.

MARINE FISHERIES INFORMATION SERVICE

No. 45

DECEMBER, 1982

Technical and Extension Series

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE

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Abbreviation— *Mar. Fish. Infor. Serv. T & E Ser.*,No. 45: 1982.

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Cover photo: R.V. Skipjack

NEW LIGHT ON THE MIGRATION OF THE INDIAN WHITE PRAWN, *PENAEUS INDICUS**

Introduction

The migratory habits of the commercial prawns of India were first investigated by means of mark recapture experiments by the All India Co-ordinated Research Project on "Studies on Marine Prawn Biology and Resources" between 1972 and 1974. Subsequently, an intensified series of mark recapture experiments on prawns were initiated at Cochin in 1976 under the National Tagging Programme (NTP) of the CMFRI and it is still in progress. All the past inquiries had indicated that these prawns are not extensive migrants and that their movements are rather restricted to the regions from where they were normally fished. Over the years this concept appeared to have gained a degree of general acceptance except for a few inferences from indirect evidences. Against this background an unexpected report which was received of the capture of a specimen of the Indian white prawn *Penaeus indicus*, which was tagged and released 42 days earlier in the Cochin harbour, at Ovari (Tinnevelli coast) situated 330 km away on July 5, claims special attention. A few more reports of distant recoveries soon followed. In this article the implications of this new finding shall be examined along with other related information obtained so far from the mark recapture experiments conducted on prawns by the NTP at Cochin, though detailed analysis of the data on many other aspects of the shrimp populations is not intended as they would be published elsewhere in due course.

The mark recovery experiments conducted by the All India Co-ordinated Research Project at Goa (M.M.Kunju and others), Cochin (P.V.Rao and others) and Madras (M.S.Muthu) yielded an overall recovery of 2.1% from a total of 3,053 prawns marked with Petersen disc tag and released in the marine and estuarine environments. The prawns were not found to move far from the fishing grounds except for the single instance of one *Metapenaeus dobsoni* released at Goa having travelled in the sea for 60 km in 10 days (Anon, 1975).

Mark recapture investigations of the NTP

Past researches on the fishery and biology of commercial prawns off Cochin have indicated that most of the penaeid prawns of this area migrate in varying degrees into the backwaters of Cochin from the sea during their larval and postlarval stages and that on approaching adulthood after having used the backwaters as nursery and feeding grounds they emigrate to the sea, where they support a fishery, (George 1962, George & Vedavyasa Rao 1967, Mohamed and Vedavyasa Rao 1977, Vedavyasa Rao 1972 and many others). If the shrimp fishery off Cochin is sustained by emigration from the Cochin backwaters, as is generally assumed, mark recapture studies could provide a better picture of this phenomenon. Therefore the main thrust of the mark recapture experiments conducted by the NTP from 1976 to 1980 and in 1982 had been to observe the emigration of the commercial species from the backwaters of Cochin to the sea, though incidentally the experiments would also yield information on growth rate and other useful population parameters.

The tag and tagging method

Loop tag made up of a coloured plastic strip 18 mm long, 3 mm wide and 0.5 mm thick with rounded corners and a pinhole at one end through which is passed a nylon monofilament with its end fused to form a bulb that will not slip through the hole was used through out the experiment. Serially numbered tags of colours red, blue or green, were employed depending on the availability of the raw material for making the tags.

Prawns conditioned for a while in retaining cages or vessels were fransfered to shallow basins containing sea water and individually measured over a fish measuring scale. The size and other details were recorded against the serial number of the tag to be used. A hypodermic needle was passed laterally through the first or second abdominal segment of the prawn without injuring its vital organs. The free end of the tag filament was passed through the bore of the needle from its pointed end till it became visible at the other end and the needle was then pulled out. The end of the filament that had passed through the body of the prawn was threaded through the pinhole on the plastic strip and fused to form a bulb using a glowing stick (Fig. 1 & 2). The dry male inflorescence of Anjili tree which could be collected easily during the season and stocked were ideal for the purpose. The tagged prawns were retained for some time and released after removing the dead and weak ones.

*Prepared by National Tagging Project Team

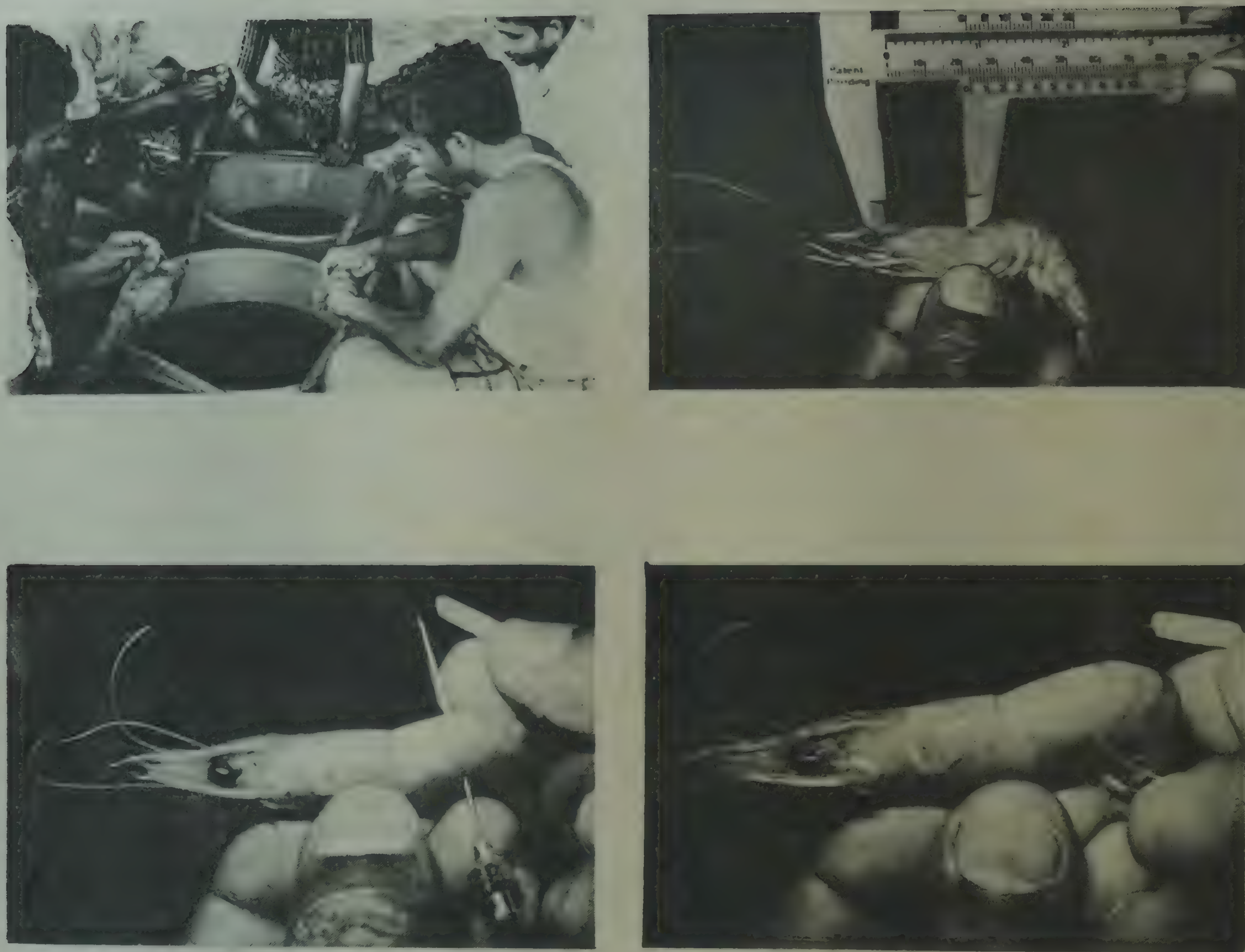

Fig. 1. Tagging procedure.

The mark recapture experiments were conducted at sea as well as in the backwater. In the sea they were performed in the traditional shrimp trawling grounds off Cochin between the 15 m and 25 m depth zones. Live prawns for the purpose were taken from this area using a shrimp trawl operated by the departmental vessel CADALMIN I and from commercial trawlers. For the experiments in the backwaters the prawns were collected using a "try net" (a small trawl net of special design operable in the backwaters) from M.L. MANTHA, a small research boat of this institute.

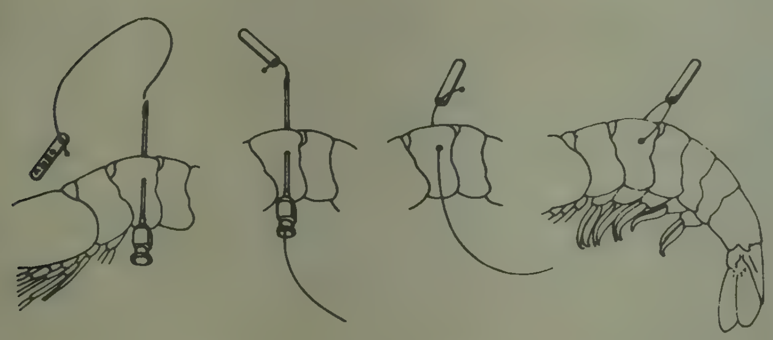

Fig. 2. Various stages of tagging.

Publicity

Propaganda for the return of recaptured tagged prawns were mainly through distribution of hand bills and display of wall posters throughout the fishing centres, fish markets and other strategic places besides periodic personal contacts with those engaged, at the various levels, in the fishing industry. An incentive reward of Rs.3/– for each prawn with tag and Rs.1/– for tag alone with details of place, date and size of the prawn was announced. Lately, this amount has been raised to Rs.5/– and Rs.2/– respectively.

Tagging experiments

The investigation was executed in four sequential phases. In the first three phases the tagging operations were carried out concurrently in the sea (Fig.3) and at selected centres in the backwaters (Fig.5). In phase I (1976–'77) there was only one centre in the backwaters, located in Perumbalam 25 km up the Vembanad lake from the harbour mouth at Cochin. In phase II (1978–'79) a second centre located in the Cochin harbour was added where the releases were made in the shipping channel (the Ernakulam channel) opposite

Table 1. *Summary of data on mark recapture experiments on prawns at Cochin from phases I to III (TL – Total length)*

	Phase	Release location	Number released	Size range TL (mm)	Percentage recovered	Place of recovery/ distance travelled	Days of freedom	Species
I	1976	Sea	5571	35–145	1.74	Within prawn grounds off Cochin	1–36	*P.indicus, M.dobsoni, M.affinis, M.monoceros P.stylifera*
		Backwater (Perumbalam)	636	32–75	2.52	0.5 to 1.0 km in backwaters	3–7	*M.dobsoni, M.monoceros, P.monodon*
I	1977	Sea	4128	52–151	0.97	Within fishing grounds off Cochin	3–40	*P.indicus, M.dobsoni, M.affinis, P.stylifera*
		Backwater (Perumbalam)	5101	35–68	1.85	0–2 km in backwater	6–17	*P.indicus, P.semisulcatus, P.monodon, M.dobsoni, M.monoceros, P.stylifera*
II	1978	Sea	4125	59–117	1.50	Within prawn grounds off Cochin	5–27	*P.indicus, P.semisulcatus, M.dobsoni, M.monoceros, M.affinis, P.stylifera*
		Backwater (Perumbalam)	1413	38–75	0.50	0–2km in backwater	7–10	*P.indicus, P.monodon, M.dobsoni*
		Backwater (Cochin harbour)	2523	35–122	0.99	Within prawn grounds off Cochin and 0.5–3 km in backwater	5–14	*P.indicus, P.semisulcatus, M.dobsoni*
II	1979	Sea	97	40–120	0	0	0	*P.indicus, M.dobsoni, M.monoceros*
		Backwater (Perumbalam)	420	34–73	9.5	0.5–1.0 km in backwater	5–15	*P.indicus, M.dobsoni, M.monoceros*
		Backwater (Cochin harbour)	13492	30–80	38.0	Within prawn grounds off Cochin and 0–5 km in backwater	1–25	*P.indicus, P.semisulcatus, M.dobsoni, M.affinis, M.monoceros*
III	1980	Sea	2341	50–164	7.0	Prawn grounds off Cochin	1–10	*P.indicus, M.dobsoni, P.stylifera*
		Backwater (Cochin harbour)	12859	36–120	0.22	0.5–8.0 km in backwater	1–21	*P.indicus, P.semisulcatus, P.monodon*

the oil tanker berth 4 km from the sea. In phase III the perumbalam centre was discontinued. Besides tagging and releasing of prawns in the natural environments experiments were also conducted on the growth rate, tagging mortality and tag suitability by maintaining tagged prawns in a tidal pond at Perumbalam. In phase IV (1982) the tagging operations were restricted to the harbour centre where the marking experiment was intensified during April to July when the seaward migration of the prawns was expected to be more. The data on release and recapture of prawns are presented in Tables 1,2 and 3.

Results in brief

Experiments in the sea: The experiments in phase I to III in which 16,262 prawns constituting *P.indicus M.dobsoni M.monoceros, M.affinis* and *Parapenaeopsis stylifera* were released showed that there was no migration beyond the area from which they were fished, tagged and released. The overall recovery was 0.86%.

Experiments in the backwaters

The experiments at Perumbalam in which 5,737 prwns were tagged in phase I and 1,833 prawns in phase II indicated that there was hardly any seaward migration of prawns from this area which was 25 km away from the sea. Perhaps this was to be expected since only small size groups occurred here. The potential emigrants are presumably to be found closer to the sea. The percentage recovery at this centre has been 3.59.

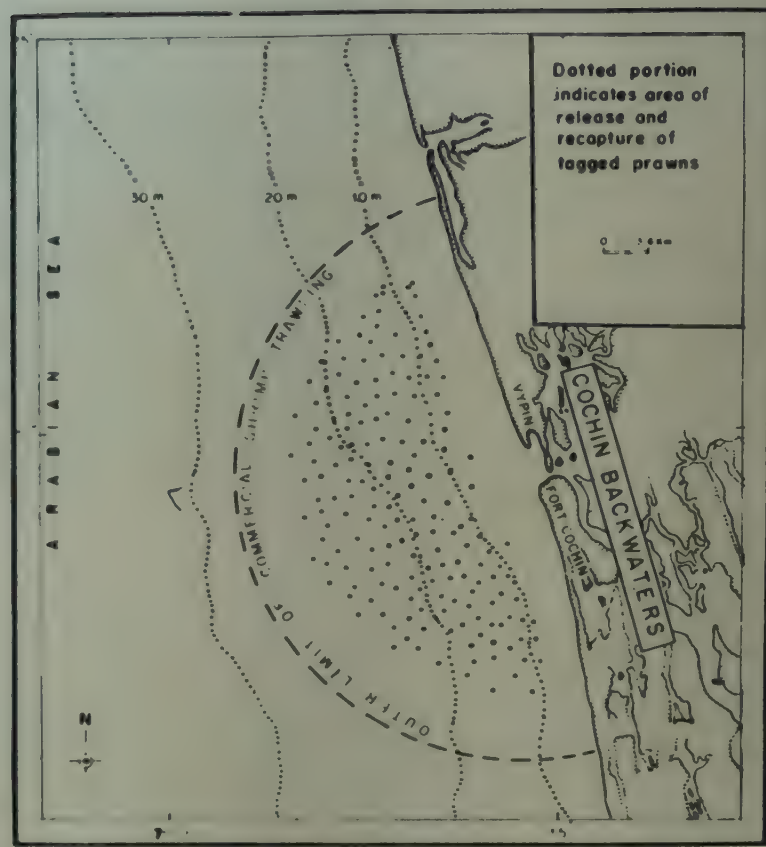

Fig. 3. Area of release and recapture of tagged prawns in the sea off Cochin.

Table. 2. *Summary of data on releases from harbour centre and recoveries from the backwaters and inshore sea of Cochin during Phase IV*

Details of releases				Recoveries from backwaters				Recoveries from inshore sea off Cochin			
Species	Month of release	Number released	Size range at release TL mm	Number recovered	Distance travelled Km	Days of freedom	Growth rates mm/day	No.* re-covered	Distance travelled Km	Days of freedom	Growth rates mm/day
P.indicus	April	1338	60.0-146.5	44	0-5	1-38	1.20	13	within fishing grounds	4-76	0.87
	May	990	62.5-136.0	67	0-5	1-27	0.90	10	"	12-39	0.64
	June	1542	52.5-122.5	59	0-6	1-36	0.70	31	"	1-50	0.61
M.affinis	April	678	48.4-108.0	3	0-5	1-16	0.80	4	"	4-43	1.10
	May	919	55.5-119.0	42	0-5	1-22	0.60	5	"	8-28	0.70
	June	204	52.7- 80.4	15	0-5	6-31	0.80	5	"	17-34	0.58
	July	120	55.5- 78.0	19	0-5	10-25	0.60	—	—	—	—
M.monoceros	April	907	59.0-103.5	11	0-5	1-11	0.60	2	"	4-33	0.75
	May	637	52.7-110.3	17	0-5	1-28	0.70	13	"	16-30	0.65
	June	879	53.1-112.5	36	0-5	1-40	0.50	7	"	3-23	0.63
	July	63	47.3-212.9	41	0-5	1-38	1.00	—	—	—	—
M.dobsoni	April	45									
	May	55									
	June	82	50.0- 82.0	2	1	20	0.80	2	—	2-19	1.10
	July	221		10	4	46	0.50	—	—	—	—
P.semisulcatus	April	41									
	May	7	75.5-104.0	—	—	—	—	—	—	—	—
	June	12									

* Date of 17 recoveries are not presented, the information being undependable.

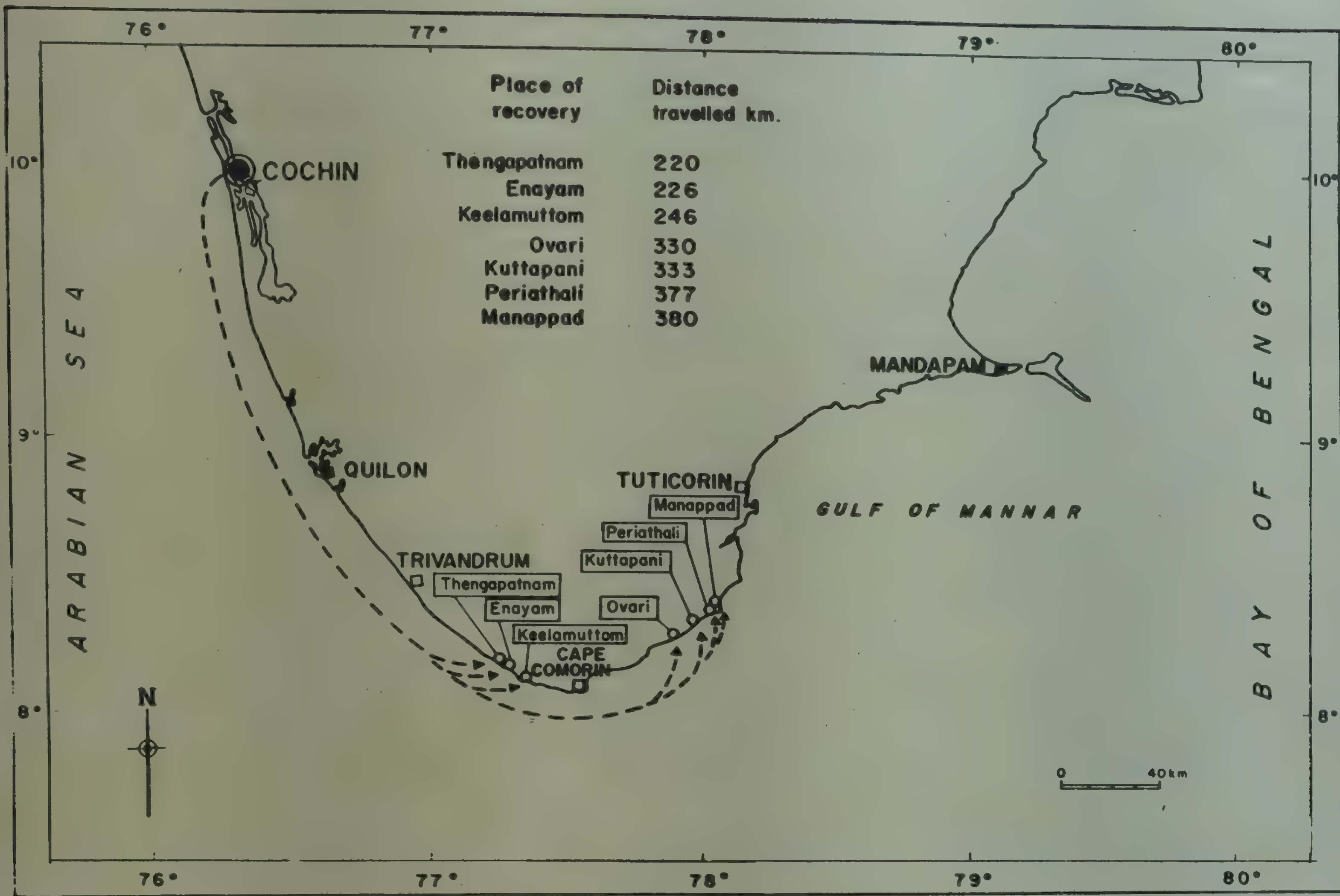

Fig. 4. Distant migration of tagged prawns

Table. 3. *Details of distant recoveries of P.indicus released from harbour centre at Cochin: Phase IV (15 April to 6 July 1982)*

Tag number	Released on	Recovered on	Days of freedom	Sex	TL at release mm	TL at recovery mm	Growth in freedom mm	Growth rate mm/day	Place of recovery	Distance from release km	Average speed km/day
A 2793	29-4-82	5-7-82	61	♂	106.0	148.0	42.0	0.69	Ovari	330	5.41
A 2401	29-4-82	13-7-82	75	♂	99.0	140.0	41.0	0.53	Tengapatnam	220	2.93
A 3188	1-5-82	11-8-82	103	♂	80.0	152.0	72.0	0.70	Kuttapani	333	3.23
A 4780	22-5-82	21-7-82	68	♂	110.0	149.0	39.0	0.57	Manappad	380	5.58
A 5349	29-5-82	2-8-82	94	♂	86.5	153.0	66.5	0.70	Ovari	330	3.51
A 5507	29-5-82	13-7-82	45	♂	106.0	127.0	21.0	0.47	Keelamuttom	246	5.47
A 6390	3-6-82	9-9-82	99	♀	82.0	179.0	97.0	0.98	Periathali	377	3.81
?	?	10-7-82*	—	?	—	(140 ?)	—	—	Enayam	226	—

* The prawn was lost by the fishermen who could remember the date and approximate size.

It was a surprise that, even from the harbour centre which was as close as 4 km to the sea, the recoveries were mostly from within the harbour and nearby backwater areas. Of the 28,874 prawns tagged and

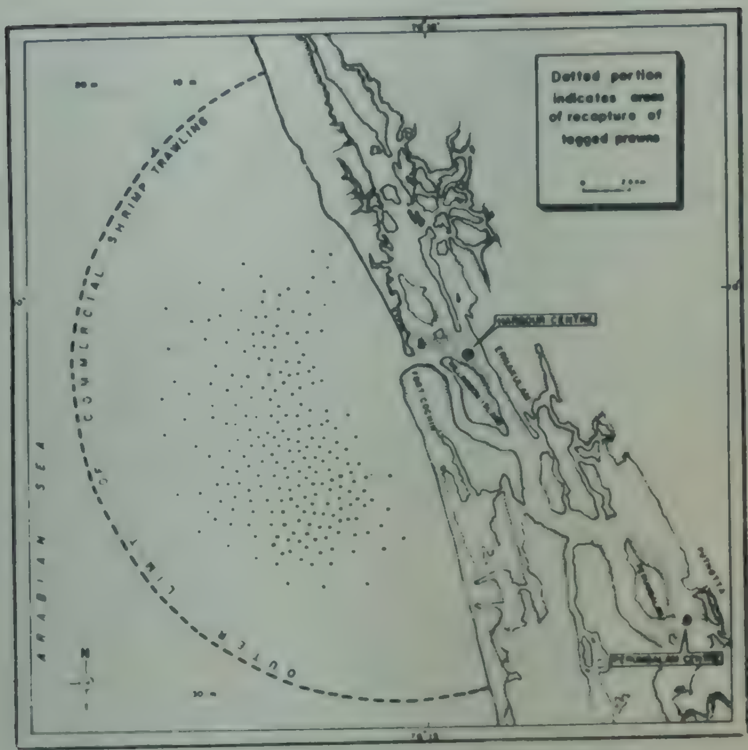

Fig. 5. The tagging centres in Cochin backwaters and areas of local recoveries.

released from this centre in phases II and III only 11 prawns, all of them *P.indicus,* had been recaptured from the sea (Table 4). Of the 11 prawns recovered from the sea 5 were recovered during February, April and May 1978 and 6 during January, February, March and August 1979, indicating that whatever emigration to the sea that occurs is spread over these months.

Examining the data on the eleven prawns, a relationship is discernible between the size of the prawns at release and the number of days lapsed before their recovery from sea, the larger their size at release in the backwater, the quicker has been their recovery from sea (Table 5). Obviously those which are smaller than 44 mm linger in the backwaters till they are 50 mm to begin their seaward migration. Therefore, in phase IV the lower size limit for tagging was raised from 35 mm to 50 mm so that a greater number could be expected to be recovered from the sea. The size at which the prawns begin to migrate from the backwaters of Cochin to the sea has been considered to be 110 - 120 mm by George (1962) and 80 mm by Mohamed & Rao (1971). However, the lower size limit for tagging during this phase was raised to only 50 mm instead of the minimum size reported by the above authors in order to study the intensity of migration among the size groups below 80 mm.

Table 4. *Data on P.indicus released from harbour centre and recovered from shrimp trawling grounds off Cochin*

Year & month of recovery	No. recovered	TL at release, mm	TL at recovery, mm	Days of free-dom
1978				
February	1	44.0	72.0	20
April	2	78.0	87.1	7
May	2	88.0	93.2	4
		77.0	85.4	6
1979				
January	1	38.0	62.0	20
February	1	56.0	67.7	9
March	2	78.0	86.4	6
		59.0	70.7	9
August	2	41.0	61.8	16
		80.0	86.0	5

In phase IV, 8,740 prawns *(P.indicus, P.semisulcatus, P.monodon, M.dobsoni, M.monoceros* and *M.affinis)* were tagged and released from the harbour centre between 15th April and 6th July 1982. It was from this that 7 prawns of *P.indicus,* were recovered in the Tinnevelli and Kanyakumari coasts (Fig.4). The local and the distant recoveries from this experiment are dealt with separately.

The local recoveries

The recoveries up to the time of the compilation of this article has been 109 (1.22%) from the sea and 366 (4.19%) from the backwater. The percentage of recovery from the sea may be a very close reflection of the intensity of migration of prawns from the Cochin backwaters during the period since all the shrimp trawlers operating off Cochin have to bring their catch to the Cochin Fisheries Harbour where the CMFRI has a unit and the situation was ideal for closely monitoring the trawler landings of tagged prawns. Whereas, the percentage of recovery from the bakwaters is likely to be an under estimate since the fishery within the backwaters, being subsistance and artisanal in character, is varied, widely scattered with unregulated disposal of

Table 5. *Relationship of size of P.indicus at release in the backwater and time taken for recovery from the sea.*

1978		1979	
size mm	Number of days	Size	No.of days
44	20	38	20
77	6	41	16
78	7	56	9
80	7	59	9
88	4	80	5

catches and hence prone to a high degree of non reporting of recoveries. Yet the number recovered from the backwaters has been more than three times of that recovered from the sea.

While the necessary data for making reliable estimates of the prawn population of the trawling grounds off Cochin are available, the absence of it for assessing the density of the juvenile stock in Cochin backwaters percludes any attempt to evaluate the contribution made by emigrant prawns from these nursery areas to the stock that sustains the prawn fishery off Cochin. Yet it may broadly be assumed from the above mentioned result obtained by the tagging experiment that hardly one third of the prawn population in the backwaters reaches the trawling grounds.

The distant recoveries

As the data from phase IV was being sorted out the first reports of the recovery of naran chemmeen *P.indicus* from Ovari and Manappad in the Tinnevelli coast 330 and 380 km respectively from Cochin was received in July 1982. The recovery from such great distance, of prawns which were tagged and released in the Cochin harbour was beyond the anticipations of the present investigation. Based on the past results, all of which indicated only localised migration, the propaganda aimed at recoveries was not geared to cover such far flung places. A hurriedly organised publicity campaign yeilded a few more recoveries (Table 3). The recoveries were from Manappad, Periathali,Ovari and Kuttapani in the southeast coast and from Thengapatnam, Keelamuttom and Enayam in the southwest coast. The longest distance covered by the prawns has been 380 km and the shortest 220 km, at speeds that varied from 2.93 km to 5.58 km per day. Prawns belonging to the same batch of release have travelled at different speeds. Two of which were released on 29th April 1982 and were recaptured at Ovari and Thengapatnam have moved at the rate of 5.41 km and 2.93 km per day respectively. In another case the speed of the prawns which were released on 29th May 1982 and recovered from Ovari and Keelamuttom had been 3.51 and 5.47 km per day respectively. Studying the prawn fishery of Kanyakumari district an interesting phenomenon noticed by Suseelan (1973) was the movement of shoals of *P.indicus*. from Colachel to Manakudy during the monsoon months and in the reverse direction during Novermber. He observed that the shoals take about 3-4 days to cover the distance of about 32 km between the two centres. Of the seven prawns which were recovered, only one was a female. The rarity of females in the recoveries is in conformity with the observations of earlier workers on the fishery of this area.

It may be mentioned in this context that certain species of penaeid prawns have been known to perform long migrations in the American, Australian and Japanese coasts. The distance of 380 km covered by the *P.indicus* released at Cochin is great compared to the migration of 193 km by the American pink shrimp *P.d.duorarum* along the North coast; the 314 km of the brown shrimp *P.a.aztecus* of Texas, the 170 km of the kuruma shrimp *P.japonicus* in the western Seto sea and the 120 km of the Australian school prawn *M.macleayi*, although the record migrations are the 580 km of the American white shrimp *P.setiferus* along Cape Kannedy and the 930 km of the Australian king prawn *P.plebejus* along the southwest coast of Australia.

Migratory pattern of Naran Chemmeen

From our knowledge of the biology of *P.indicus* they are supposed to move from the inshore trawling grounds off Cochin to deeper waters for breeding since, only few spawners come in the trawl catches. Examining the possibility of coastwise movements George *et al* (1967) felt that the knowledge till date did not indicate this in the Cochin region and that only mark recapture investigations could clarify this.

That the prawn fishery in the Kanyakumari district and at Manappad, which are mainly composed of large size *P.indicus*, are probably supported by recruitment from the Kerala coast was inferred by George and Mohamed (1967) and Mary Manisseri & Manimaran (1981) after examining the respective fisheries. The present investigation provides the first direct evidence that *P.indicus* nurtured in the Cochin backwaters would in deed move into the sea and migrate southward along the west coast, skirt round Cape Comorin and proceed further along the southeast coast up to Manappad. The available informationonthe nature and composition of the prawn fishery along the coasts traversed by the migrating *P.indicus* reveal that Manappad is the northern limit up to which this species dominates the landings and that north of Manappad the tiger prawn *P.semisulcatus* forms the main stay of the catches. Significantly, there has been no recovery from north of Manappad which seems to be the end point of the migration of naran chemmeen from Cochin.

It is apparent that this migration was aided by the prevailing current since, from February to October a southerly component of the equatorial current of 0.5 kt. magnitude follows the coast line of India in the west while a northerly component follows the coast line in the east (Varadachari & Sharma, 1967). However, the prawns that were released in the same batch appear to have moved at different speeds. The data in hand is inadequate to infer whether this suggests a size oriented schooling and whether they exercise any control over their speed and magnitude of their migration.

The one female prawn which was recovered from the Tinnevelli coast was in the spent condition and the other males had grown to the breeding size. It is probable that the movement of these prawns was a breeding migration though more evidence is needed to confirm this.

Growth of prawns

While migrating, the prawns had grown at an average rate of 0.6 mm/day among the males and 0.98 mm/day in the case of the single female which was recovered. Recoveries from the inshore areas of Cochin (Table 4) indicated a growth of 0.61 to 0.87 mm/day in *P.indicus*, 0.58-1.10 mm/day in *M.affinis*, 0.63-0.75 mm/day in *M.monoceros* and 1.10 mm/day in *M.dobsoni*. From the table it will be seen that the growth rates were some what faster in the case of prawns recovered from the backwater ie. 0.70- 1.20 mm/day in *P.indicus*, 0.60-0.80 mm/day in *M.affinis* and 0.50-1.00 mm/day in *M.monoceros*. The growth rates observed in the case of *P.indicus* are much higher than what has been recorded from the earlier length frequency studies, 20.0 mm/4 months ie. 0.17 mm/day in males and 15.0 mm/4 months (ie. 0.13 mm/day) in females by George *et al* (1963) for the species in the off shore waters of Cochin and 15.0 mm/4 months (ie. 0.13 mm/day) in males and 5.0 mm/month (ie. 0.17 mm/day) in females by George & Mohamed (1967) from the inshore fishing grounds of Kanyakumari district. At the same time the results of experiments of intensive culture of the species conducted in culture ponds and farms have indicated much faster growth rates upto nearly 2.5 mm/day (Mohamed *et al* 1980 and Mohamed, personal communication). Comparably higher growth rates have been obtained in the present results from tagged specimens of *P.indicus* in the experimental pond at Perumbalam (Fig.6). Despite the possible effects of tagging, a growth rate of 63.3 mm/month ie. 2.11 mm / day, which is higher than the maximum so far recorded for this species from the brackishwater environments of India, (Jhingran & Natarajan, 1969; Suseelan, 1975) was recorded.

General Remarks

The most interesting and significant point which emerges from the long distance tag recoveries is that at least part of the fishery of *P.indicus* along the south east coast, if not the whole, is supported by the juvenile population from the Cochin area. Although some indirect evidences had pointed to this possibility as suggested by George & Mohamed (1967) and Mary Manisseri & Manimaran (1981) the present results categorically establish the fact that to a certain extent the *P.indicus* population of Tinnevelli coast is replenished by prawns migrating from the backwaters of Cochin. However, these mark recapture results of the NTP in general and the long distance recoveries in particular raise more questions than answers, the answers to which may greatly change our appreciation of the characteristics of the shrimp population in these waters.

For instance, it is not known what part of the population of *P.indicus* occurring in Cochin area undertakes the southerly migration and contributes to the fishery on the south east coast. Studies on the East Australian king prawn, a related species, have shown that part of the population migrates long distances while those which are left behind spawn in the nearby estuaries (Ruello, 1975). In case only part of the shrimp population of the southern region is contributed by recruitment from Cochin area, the possibility of these prawns completing their life cycle in the sea itself on the southeast coast and contributing to the rest of the fishery there cannot be ruled out, as there are no large scale brackish water areas nearby to serve as nursery grounds.

It is equally intriguing that not a single tagged prawn involved in this southerly migration was captured in the trawl fishery operating off Quilon which is located enroute, in spite of the large scale publicity work and propaganda for recoveries at Quilon.

Fig. 6. Tidal pond at Perumbalam where tagging experiments were conducted on prawns to study the growth rate, tagging mortality and tag suitability.

Similarly, as the recoveries of tagged prawns from the shrimping grounds tend to indicate, only a fraction of prawn population from the Cochin backwaters contributes to the stock that supports a year long shrimp fishery off Cochin, obviously the marine shrimp stock is sustained by inputs from other sources also, either by ingress from elsewhere or by self replenishment or both. Here it is pertinent to recall the observation made by Mohamed and Rao (1971) while discussing

the estuarine phase in the life history of prawns in the west coast of India. Trying to explain the fair representation of smaller sizes of the species in the inshore population, the authors suggest that it indicates the probability of the prawn completing the life cycle in the sea itself.

If a species like *P.indicus* which is an important constituent of the prawn population that supports the fishery off Cochin migrates away from the population, as the present results suggest, the phenomenon will have to be properly evaluated for its incorporation in the assessment of the local stock. It has also to be investigated whether recruitment into the Cochin prawn grounds takes place from the northern regions along the Kerala and Karnataka coasts which yield substantial shrimp landings.

Undoubtedly, these results serve only as pointers and suitable mark recapture experiments to study more comprehensively the migration and other aspects of the species would be the immediate concern of the NTP. The results will naturally have far reaching implications with regard to our approach to the assessment of the shrimp stocks, their exploitation and management.

Participants in the NTP

The following individuals were involved, as stated, with this investigation during its various phases and the preparation of this article: P. Vijayaraghavan – Project leader (planning, organizing, leading tagging teams, analysis and interpretation of data, propaganda, preparation of the article); M.M. Thomas – Associate Project Leader (support and advice in planning and organising, leading tagging teams, tagging and propaganda); A. Noble – Associate Project Leader (leading tagging teams, tagging and propaganda); K.N. Gopalakrishnan – Tagging, registering data, help in analysis of data; K. Chellappan – Tagging, registering data; C. Suseelan – Tagging, valuable discussions; M. Rajamani – tagging, sending the first and subsequent reports of recovery of marked prawns from Tinnevelly coast, propaganda; S.G. Vincent – reporting recovery from south west coast, propaganda; Habib – propaganda north of Tuticorin; P.M. Aboobacker, M. Ayyappan Pillai, P.L. Ammini, V.P. Annam, V.K. Balachandran, K. Balachandran, G. Balakrishnan, V.K. Balakrishnan, K. Balan, K.K. Balasubramaniam, G. Bharathan, S.R. Chakraborthy, V. Chandrika, Daniel Selvaraj, D.V. Dattatraya, I. David Raj, D.C.V. Easterson, K.C. George, K.V. George, Gita Antony, G. Gopakumar, C.P. Gopinathan, Grace Mathew, S. Haja Nazeemudeen, Jacob D. Eapen A.A. Jayaprakash, V.S. Kakati, L.P. Khambadkar, A. Kanakam, K.N.R. Kartha, M. Kathirvel, M.N. Kesavan Elayath, P. Kumaraswamy, L. Krishnan, G. Krishnankutty Nair, Krishna Srinath, C.H. Kunjiraman, V. Kunjukrishna Pillai, G.P. Kumaraswamy Achari, N. Surendranatha Kurup, S. Lalitha Devi, A. Laxminarayana, S. Lakshmi, Madanmohan, P.K. Mahadevan Pillai, K.J. Mathew, M.M Meiyappan, H. Mohamed Kasim, C. Mukundan, M.S. Muthu, C.Nalini, K. Nandakumar, K. Narayana Kurup, V.A. Narayanankutty, J.Narayanaswamy, M. Abdul Nizar, K. Nandakumaran, M.V. Pai, K.K.P. Panikkar, P.P. Pillai, G. Ponniah, B. Prassanna Kumari, G. Radhakrishnan, E.V. Radhakrishnan, K.V. Raghavan, R. Reghu, A. Regunathan, M.S. Rajagopalan, V. Rajendran, N. Ramachandran, P.V. Ramachandran Nair, C.P. Ramamritham, D.S. Rao, G.S. Rao, D.B.F Sahare, R. Sathiadas, U.K. Sathiavan, C.R. Sanmughavelu, R. Sivaraman, K.V. Somasekharan Nair, P.V. Srinivasan, M. Srinath, G. Subbaraju, Syed Ahmed Ali, G. Syda Rao, C. C. Thankappan Pillai, V. Thangaraj Subramanian, A.R. Thirunavukarasu, K.K. Valsala, Varghese Jacob, Varghese Philippose, R. Vasanthakumar, M. Vijayakumaran, K. Vijayalakshmi, D. Vincent, K.P. Viswanathan and K.C. Yohannan – tagging.

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भारत का राजपत्र
The Gazette of India

असाधारण
EXTRAORDINARY

भाग II—खण्ड 3—उप-खण्ड (ii)
PART II—Section 3—Sub-section (ii)

प्राधिकार से प्रकाशित
PUBLISHED BY AUTHORITY

383] नई दिल्ली, बृहस्पतिवार, अगस्त 26, 1982/भाद्र 4, 1904
383] NEW DELHI, THURSDAY, AUGUST 26, 1982/BHADRA 4, 1904

इस भाग में भिन्न पृष्ठ संख्या दी जाती है जिससे कि यह अलग संकलन के रूप में रखा जा सके

Separate Paging is given to this Part in order that it may be filed as a separate compilation

MINISTRY OF AGRICULTURE

(Department of Agriculture and Cooperation)

NOTIFICATION

New Delhi, the 26th August, 1982

G.S.R. 619(E).—In exericse of the powers conferred by section 25 of the Maritime Zones of India (Regulation of Fishing by Foreign Vessels) Act, 1981 (42 of 1981), the Central Government hereby make the following rules, namely :

1. Short title and commencement.—(1) These rules may be called the Maritime Zones of India (Regulation of Fishing by Foreign Vessels) Rules, 1982.

(2) They shall come into force on the date of their publication in the Official Gazette.

2. Definitions.—In these rules, unless the context otherwise requires :—

(a) "Act" means the Maritime Zones of India (Regulation of Fishing by Foreign Vessels Act, 1981 (42 of 1981);

(b) "crew" includes the team of technical, semi technical and non-technical member associated with the operation of the fishing vessels ;

(c) "flag state" in relation to a foreign vessel means the State in which the vessel is registered or, where the vessel is not registered, the State whose flag the vessel is entitled to fly ;

(d) "Form" means a Form annexed to these rules ;

(e) "licence" means a licence granted under section 4 ;

(f) "permit" means a permit granted under section 5 or under section 8, as the case may be ;

(g) "Schedule" means Schedule to these rules ;

(h) words and expressions used but not defined in these rules but defined in the Maritime Zones of India (Regulation of Fishing by Foreign Vessels) Act, 1981 (42 of 1981) shall have the meanings respectively assigned to them in that Act.

3. Licences.—(1) Every owner of a foreign vessel or any other person described in section 4, who intends to use such vessel for fishing within any maritime zone of India, shall make an application in Form A to the Central Government. This form shall include the following information :—

(a) the name and description of the vessel, its equipment and complement ;

(b) the flag state and home port of the vessel :

(c) the name and address of the owner and master of the vessel and, where applicable, its character ;

(d) the side number of the vessel, the radio frequencies and call sign ;

(e) a description of the proposed purpose and the period for which the licence is required ;

(f) the name and address of a person resident in India having a permanent office or establishment in India who is authorised by the owner of the vessel to represent him for the purpose of providing liaison with the Government of India ; and

(g) any information required by the Central Government or by an officer designated by it to grant a licence in any case where, in its opinion the information furnished by the applicant requires clarification or amplification.

(2) Every application referred to in sub-rule (1) shall be made not less than thirty days prior to the first day on which the licence is required ;

(3) Every such application shall be accompanied by a fee of rupees five hundred which shall not be refundable.

(4) The Central Government or an officer designated by it may, on receipt of an application, after making such enquiry as may be relevant, grant a licence in Form B for all or any of the following purposes, namely :—

(i) to engage in commercial fishing ;

(ii) to tranship or to take on board any fish, outfit or supplies while at sea ;

(iii) to process fish at sea ;

(iv) to transport fish from fishing grounds ;

(v) to land fish or fish products at an Indian port ;

(vi) to purchase or obtain bait, outfits, provisions or supplies (including fuel) at an Indian port ;

(vii) to effect repairs at an Indian Port ;

4. Validity of Licence : (1) Every licence shall,—

(a) be issued in original duplicates ; and authenticated copies shall be distributed to enforcement and other concerned authorities ;

(b) apply only to the foreign vessel described in the licence and, where applicable, to the crew of that vessel ; and

(c) be valid for the period specified in the licence.

(2) The disposition of the duplicates referred to in clause (a) of sub-rule (1) shall be as follows :—

(a) one licence shall be for the use of the licensee ; and

(b) one licence shall be retained by the Central Government.

5. Terms and conditions of licence.—(1) Every licence, shall be subject to the following terms and conditions, namely :—

(a) the licensee shall pay to the Central Government an amount set out in the Schedule I for the purposes mentioned therein at the time of taking delivery of the licence ;

(b) the master of the foreign vessel for which a licence is granted or a person acting on behalf of the master shall give twenty four hours prior notice to the authorised officer of—

(i) the estimated time of entry of the vessel into the maritime zone of India ;

(ii) of the location of such entry ; and

(iii) of the approximate schedule of activities to be conducted.

(c) the vessel and its crew shall engage only in the activities that are authorised by the licence ;

(d) the activities authorised by the licence shall be carried out only at the time and in the areas of the maritime zone of India or ports set out in the licence ;

(e) the licensee shall ensure that foreign members of the crew are employed only after obtaining necessary clearance from the Central Government. The Licensee shall further ensure that every subsequent change in the foreign members of the crew is made only after the clearance from the Central Government ;

(f) the master of each foreign fishing vessel during fishing operations shall notify the authorised officer the following,—

(i) time and position of commencement of fishing ;

(ii) the time and position of the temporary departure from the fishing grounds for the purpose of embarking or disembarking an observer or for a call at an Indian port or any other temporary departure from the grounds which will involve departure from any authorised fishing are but which does not include departure from seaward limit of the fishing area beyond the Exclusive Economic Zone of India ;

(iii) the time and position of return to the fishing grounds following temporary departure described in sub-clause (ii) above ;

(iv) the time and position of any shift in its fishing area ;

(v) the time and position at which it will cease fishing and the leave the fishing area ;

(g) the master of the vessel shall communicate the information, to be notified under clause (f), to the officer of the Coast Guard in Porbander, Bombay Cochin, Tuticorin, Madras, Vishakhapatnam, Paradeep, Haldia or Port Blair, at least twenty four hours before the commencement or cessation of fishing. He shall record in communication log, the Indian Standard Time and the contents of each communication made under this clause. All the communication shall be in English ;

(h) where the fishing is authorised by the licence,—

(i) the crew of the vessel shall fish only for the stocks or groups of stocks described in the licence ;

(ii) the crew of the vessel shall not catch any fish by a species, size or age set out in the licence as prohibited catches, that are covered under the Wild Life (Protection) Act, 1972 (53 of 1972) and where such fish are caught they shall be retained and preserved on board the vessel, accounted for in Form C and shall be surrendered at such places as may be directed by the authorised officer ;

(iii) the quantities of fish of any stock or group of stocks caught in any area of the maritime zone of India during the terms of licence, or during any specified portion thereof, shall not exceed the quantities set out in the licence ;

(iv) the crew of the vessel shall not discard any substantial quantities of fish of a stock or group of stocks caught in excess of the quantities set in the licence. Such quantities of stock or group of stocks shall be retained and preserved on board the vessel accounted for in Form D and shall be surrendered at such place as may be directed by the authorised officer ,

(v) the crew of the vessel shall fish only by means of fishing equipment and gear of a kind set out in the licence ; and

(vi) the master of the vessel shall cause written records to be maintained on a daily basis of the fishing effort and catch of the vessel and of any transhipment and other dispositions of the catch by quantities, species size and weight in Form E.

(i) where the transporting of fish from fishing grounds is authorised by the licence—

(i) Only the species and quantities of fish set out in the licence shall be taken on board the vessel for that purpose;

(ii) the fish may be taken on board only from vessel of a class set out in the licence; and

(iii) the master of the vessel shall cause written records to be maintained on a daily basis of the fish taken on board the vessel for transportation in Form F;

(j) where the processing of fish is authorised by the licence, the master of the vessel shall cause written records to be maintained on a daily basis of the processing operations carried out and of the species, quantity and the State of processing of the fish taken on board the vessel for that purpose in Form G;

(k) the vessel shall have on board at all time during the period it is in maritime zone of India, equipment and fishing gear, including communications equipment, described in the licence as "required equipment";

(l) the master of the vessel or a person acting on behalf of the master shall, when authorised by the licence to visit an Indian Port, notify the authority specified in the licence of the estimated time of entry of the vessel into that port not less than twenty four hours prior to that estimated time;

(m) where the vessel is in an area of the maritime zone of India and is not authorised by its licence to engage in fishing at that time in that area, all fishing gear on board the vessel shall be stowed in the manner specified in rule 14;

(n) the master of the vessel shall cause reports to be made of the position of the vessel in space and time, operational conditions, and the nature of fishing including, where applicable, its catch statistics, and any transhipments or other dispositions of its catch, at such times, to such persons and by such means as are set out in the licence.

(o) where the Central Government requires the vessel to carry out, from time to time, a programme of sampling, observation or research in connection with fisheries in the maritime zone of India, the master shall comply with instructions issued to him by the Government in respect of that programme;

(p) the master of the vessel shall, where required by the Central Government or an officer authorised in this behalf, permit a technical observer or observers designated in writing by that Government to go on board and remain on board, at a time and for a period specified in that behalf, for the purpose of recording scientific data and observations or taking samples and records or any other purpose specified in the order;

(q) the master of the vessel shall take all reasonable precautions to ensure the safety of any authorised officer or technical observer boarding or leaving the vessel at sea including the observance of practice of good seamanship and, where necessary, the placing of a boarding ladder of good quality and design and safety line over the side of the vessel;

(r) where an authorised officer or technical observer is on board the vessel for a period of more than four hours the master of the vessel shall provide the authorised officer or technical observer with suitable food and accommodation;

(s) the master of the vessel shall—

(i) at the request of an authorised officer or technical observer, arrange for that officer or observer to send or receive messages by means of communication facilities on board the vessel;

(ii) provide all reasonable assistance in his power to enable an authorised officer or technical observer to carry out his duties and functions, and to the use of vessel's navigation equipment and personnel as necessary to determine the vessels's position.

(t) the master of the vessel shall, at any time, while within the maritime zone of India, at the request of an authorised officer, proceed forthwith for inspection to a place at sea and to a port as may be specified by that officer;

(u) the master of the vessel, upon being approached by an authorised officer in a vessel or ship or in an aircraft, shall immediately comply with any directions given to him by such authorised officer. For this purpose, the International Code of Signals shall be used;

(v) The vessel shall, at all time while within the maritime zone of India,—

(i) fly the flag of the flag state;

(ii) display in a place that is clearly visible both from the air and from sea level the letters and numbers identifying the vessel as set out in its licence, in white markings of at least one metre in height in the case of a vessel whose overall length exceeds twenty metres or one-half metre in height in any other case, on a black background, and where the markings are painted, the paint work shall be maintained in good condition so that the markings are clearly legible at all times;

(w) where the vessel is in the maritime zone of India, the master of the vessel or a person acting on behalf of the master shall notify the Central Government of the estimated time of departure from those waters not less than seventy two hours prior to that estimated time;

(x) the licensee shall, when required to do so, make arrangements for training of Indian crew and personnel on board the vessels;

(2) the licensee shall be bound all or any of the terms and conditions mentioned in sub rule (1) and such additional conditions or restrictions as may be specified in the licence.

6. Permits: (1) Every Indian citizen and person described in section 5 who intends to use any foreign vessel for fishing

within any maritime zone of India shall make an application to the Central Government for a permit.

(2) Every application referred to in sub-rule (1) shall be in Form H and shall be made not less than thirty days prior to the first day on which the permit is required.

(3) Every such application shall be accompained by a fee of rupees five hundred which shall not be refundable.

(4) The Central Government or an officer designated by it may on receipt of an applications after making such enquiry as may be relevant, grant a permit in Form I for all or any of the purposes mentioned in sub-rule (4) of rule 3 of these rules.

7. Validity of permit — (1) Every permit shall,

(a) be issued in original duplicates and authenticated copies are to be distributed to enforcement and other connected authorities.

(b) be valid for a period as may be specified in the permit and in no case exceed more than five years.

(2) The disposition of the duplicates referred to in clause (b) of sub-rule (1) shall be as follows:

(a) one permit shall be for the use of the permit holder; and

(b) one permit shall be retained by the Central Government,

8.Terms and conditions of permit: (1) Every permit shall be subject to the following terms and conditions, namely:—

(a) the permit holder (herein after referred to as the charterer in this rule) shall pay to the Central Government an amount of Rupees ten thousand per vessel per year at the time of taking delivery of the permit;

(b) the charterer shall have the requisite managerial personnel who possess the necessary experience of fishing;

(c) the charterer shall give an undertaking in the form of bank guarantee, before the commencement of the charter, of an amount to be decided by the Central Government in each case to the Central Government that he shall purchase required number of vessels and put them in fishing operation in the Exclusive Economic Zone of India before the end of the stipulated period specified in the Schedule II.

(d) the charterer shall ensure that at least twenty percent of the crew are Indian citizens and are posted as under studies to the foreign skipper, the engineer and to the other operational crew and that they shall be kept in readiness to embark on the chartered vessel at the time of inspection of the vessel by the authorised officer and shall remain on board the vessel throughtout the charter period.

(e) the charterer shall ensure that the charter party provides for the settlement of disputes between the parties by arbitration in India.

(f) the Central Government may post scientist / observer on board each of the chartered vessel; the charterer shall ensure that the Indian scientists and observers, when so directed by the Central Government are permitted on board the chartered vessel for collection and examination of such data and material as may be required by that Government and shall see that such scientists and observers are provided proper food and accommodation on board the vessel by the master of the vessel;

(g) the charterer shall furnish to the Central Government valuation and sea worthiness certificates for the chartered vessel from an appropriate authority of its flag state and also furnish a copy thereof to the Director General of Shipping, Bombay;

(h) the charterer shall cause to be furnished to the Central Government the necessary certificates to the effect that the chartered vessel meets with the requirements in respect of safety of vessels and crew as per the provisions of the Merchant Shipping Act, 1958 (44 of 1958);

(i) The charterer shall ensure that,—

(i) no fishing is done for the protected species which are covered under the Wild Life (Protection) Act, 1972 (53 of 1972);

(ii) such protected species, if caught are immediately returned to water alive, if possible, and if not they shall be retained and preserved on board the vessel and accounted for in Form C and shall be surrendered at such place as may be directed by the authorised officer;

(j) the charterer shall not undertake shrimping operations for exploitation of coastal shrimps;

(k) where the charterer is a company, the paid up share capital of the company shall not be less than rupees five lakhs during the charter period;

(l) the charterer shall not pay any marketing commission without the prior approval of the Central Government;

(m) the charterer shall ensure that the chartered vessel reports to the authorised officer before and after every fishing voyage and delivers the copy of the permit in its possession to the charterer before every departure to the foreign port;

(n) the charterer shall ensure that the foreign members of the crew on the chartered vessel are employed only after obtaining necessary clearance from the Central Government;

(o) the charterer shall further ensure that every subsequent change in the foreign members of the crew is made only after the clearance from the Central Government;

(p) the charterer shall furnish to the Central Government voyage-wise statement of fish catch and exports form the chartered vessels with all the necessary details as set out in Form J;

(2) The charterer shall be bound by,—

(i) all or any of the terms and conditions mentioned in sub-rule (1);

(ii) all or any of the terms and conditions applicable to the licence except conditions prescribed in clause (a) of sub - rule (1) of rule 5, and

(iii) such additional conditions or restrictions as may be specified in the permit.

9. Display of licence or permit on board the vessel.— (1) Subject to sub-rule (2), a copy of the licence or permit, duly attested by the issuing authority,shall be kept on board the foreign vessel described in the licence or permit while that vessel is in the maritime zone of India and shall be produced for examination by an authorised officer at his request.

(2) Every foreign vessel described in the licence or permit may enter in the maritime zone of India and proceed directly to an Indian port for the purpose of obtaining a copy of the licence or permit if,—

(a) all fishing gear on board the vessel is stowed in the manner specified in rule 14;

(b) the master of the vessel complies with any directions given to him by an authorised officer.

10. Damage to Indian Vessels prohibited.— No foreign vessel fishing in the maritime zone of India under the licence or a permit granted under these rules shall cause any damage either wilfully or through gross negligence to any fishing vessel, fishing stakes, fishing gear, fishing net or other fishing appliances owned or in possession of an Indian citizen;

11. Commencement of fishing operations.— No foreign vessel fishing in the maritime zone of India Under the licence or the permit granted under these rules shall commence fishing operations without the clearance from the Coast Guards.

12 Fishing in territorial waters prohibited.—No foreign vessel shall undertake fishing operations with in the territorial waters of India, unless otherwise specifically permitted for any specialised type of fishing and shall be subject to any other restrictions that may be specified in the licence or permit.

13. Prohibition to carry any explosives, poisonous or noxious substances,— (1) No foreign vessel or any person shall carry or have in its possession or control any explosives, poisonous or other noxious substances or apparatus fitted for or capable of utilising an electric current with the intention of using such explosives, poisonous or other noxious substances or apparatus for killing, stunning, disabling or catching fish. Any explosives, poisonous or other noxious substance found on board any vessel or in possession of any person, shall be presumed, unless the contrary is proved, to be intended for the use specified above.

(2) No foreign vessel or any person shall attempt to destroy or abandon any fishing gear, fishing net or other fishing appliances, explosives, poisonous or other noxious substances or any other object or thing with the intention to avoid their detection or seizure.

14. Entry into maritime zone of India without licence / permit,— (1) subject to sub-rule (2) a foreign vessel may, without the authority of a licence or a permit enter the maritime zone of India for the purpose of passing through such waters in the course of a voyage to a destination outside the maritime zone of india.

(2) A foreign vessel that has entered in the maritime zone of India without the authority of a licence or a permit shall comply with the following conditions while in the maritime zone of india,—

(a) all fishing gear on board the vessel shall be stowed below deck or otherwise removed from the place where it is normally used for fishing and placed where it is not readily available for fishing;

(b) all fishing nets, fishing lines, hooks, jigs, trawl boards, weights and floats shall be disconnected from their towing, connecting or hauling wires, ropes or rigid frames;

(c) the master of the vessel shall comply with any directions given to him by an authorised officer; and

(d) where an authorised officer requests information respecting the name, flag state, location, route or destination of the vessel, or the circumstances under which it entered maritime zone of India, the master of the vessel shall promptly convey the information to the officer.

15. Fishing for scientific research,investigation, etc.— Where a foreign vessel is to be used for fishing within any maritime zone of India for the purpose of carrying out any scientific research or investigation or for any experimental fishing, the Central Government may grant a permit to such foreign vessel under section 8 of the Act. Where such a permission is granted, the Central Government may apply all or any of the terms and conditions prescribed for licence under the rule 5 or for permit under rule 8, as well as such additional conditions as may be specified.

16. Contravention of conditions of licence, permits of rules,— Contravention of any of the provisions of these rules shall be punishable with fine, which may extend to Rs.50,000 without prejudice to the penalties which may be awarded under the Act.

[No. 29012/2/81-Fy. (T.I)]
S.P.JAKHANWAL, Jt. Secy.

SCHEDULE I

[See rule 5 (1) (a)]

Amount payable under rule 5 (1) (a)

Purpose of licence	Amount Payable
1.Fishing by squid jigging.	Rs.1,000/-per tonne of fish the vessel is permitted by the terms and conditions of the licence.
2.Fishing by trawling.	Rs.2,000/-per tonne of fish the vessel is permitted by the terms and conditions of the licence.
3.Fishing by long lining/ gill-netting	Rs.1,500/-per tonne of the fish the vessel is permitted by the terms and conditions of the licence.
4.Fishing for tuna by long lining/purse-seining/pole and line fishing.	Rs.1,000/-per tonne of fish the vessel is permitted by the terms and conditions of the licence.
5.Transporting of fish	Rs.500/-per tonne of fish carrying capacity of the vessel for each voyage.
6.For any other purpose mentioned in rule 3 (4).	Rs.200/-per gross registered tonne of the craft for each voyage.

SCHEDULE II

[See rule 8 (1) (c)]

Schedule of purchase of vessels

No of vessels / or pair of Vessels or first vessel	No. of months from the beginning of the charter operation when obligatory purchase and fishing operation becomes due				
	First Vessel or second pair of vessel	Second Vessel or third pair of vessel	Third Vessel or fourth pair of vessel	Fourth Vessel or fifth pair of vessel	Fifth Vessel pair of vessel
1	18	..	..	..	..
2	18	30	..	..	..
3	18	24	33	..	..
4	18	24	33	42	..
5	18	24	33	42	51

FORM A

[See rule 3 (1)]

Form of Application of Licence

To

The Secretary to the Government of India,
Department of Agriculture and Cooperation,
Ministry of Agriculture,
Krishi Bhavan,
New Delhi-110 001,
India.

Sir,

I hereby apply for a licence under section 4 of the Maritime Zones of India (Regulation of Fishing by Foreign Vessels) Act, 1981, in respect of which the following particulars are furnished:

1. Name of the applicant and postal address.
2. Status of the applicant and his financial position (If the applicant is a company, full details thereof)
3. Present activities of the applicant including the specific activities relating to fishing.
4. Details of fishing vessels/fish processing units/export /import of fish as in the past three years.
5. Details of the proposed fishing project indicating particulars on fishing vessels, number of vessels to be operated, anticipated fish catch, project economics, processing and marketing arrangements, area and base of operation etc.
6. Description of the vessel, equipment and complements :—

(a) Name of the Vessel.
(b) Flag state and home port of Vessel.
(c) Country and port of registration.
(d) Registration number.
(e) Radio call sign/signal letter/radio frequencies.
(f) Name of owner and master of the vessel.
(g) Nationality and address of owner and master.
(h) Purpose of vessel (kind of vessel)
(i) Kind of vessel's hull.
(j) Vessel's year (date of construction) and date of launching.
(k) Number of deck.
(l) Number of mast.
(m) Registered length.
(n) Registered breadth.
(o) Registered depth (draft).
(p) Gross tonnage and net tonnage.
(q) Fish Hold capacity and Refrigeration Capacity.
(r) Kind of main engine, name and place of main engine manufactured.
(s) Rated H.P. of main engine.
(t) Kind of propeller.
(u) Class of equipments (list).
(v) Certified crew capacity.
(w) Service limitations of the vessel.
(x) Name and address of the ship builder
(y) Value of the vessel.
(z) Any other remarks.

7. The electrical specifications of the craft and its equpment.
8. Description of the proposed fishing operation:—

(a) the species to be fished;
(b) the method of fishing and type and dimensions of gear to be used and mesh sizes of different parts of fishing net.
(c) area/areas to be fished;
(d) the amount of fish to be caught;
(e) the period of time for which licence is sought;
(f) the place in which the fish is to be landed and/or processed.
(g) a description of support operations and the name and licence number (if any) of fishing vessels in support of which related activities are to be carried out

(9) Name and address of the person resident in India appointed by the owner to represent him in all dealings with the Government and evidence of the extent to which he is authorised to undertake legal and financial obligations on behalf of the owner.

(10) Plans for the use of Indian facilities in the support, provisioning and maintenance of vessels.

(11) Such other information as may be required by the Government of India.

Dated .... Day .... of ....of the year ...

Signature of the applicant

FORM B

[See rule 3 (4)]

Government of India
MINISTRY OF AGRICULTURE
Department of Agriculture and Cooperation New Delhi

No ....

Dated ....

Licence to Fish in the Exclusive Economic Zone of India

This Licence is granted in pursuant to section 4 of the Maritime Zones of India (Regulation of Fishing by Foreign Vessels) Act, 1981 (42 of 1981)

2. The foreign Fishing vessel described hereunder is hereby licensed for the purposes specified in paragraph 3 of this licence and in accordance with the conditions set out in paragraphs 6 and 8 of this licence and shall be subject to all the Indian laws that apply to the vessels in the Maritime Zones of India.

Description of the vessel

Name of the vessel ....

Name of the owner........................

Type of vessel ....

Country of registrtion / Flag State..................

Registration Number ....

Overall length ....

Gross tonnage....................

International radio call sign and radio frequency........

Name and address of the master ....

3. The purposes for which the vessel may be used:

4. Area:

5. Period:

6. The licence shall be bound by the terms and conditions specified in rule 5 and the additional condition / restriction specified in paragraph 8.

7. Exemptions in the terms and conditions, if any.

8. Additional conditions.

9. Names of the foreign crew:

10. List of required equipments ....
....

11. Subject to the provisions of the Maritime Zones of India (Regulation of Fishing by Foreign Vessels) Rules, 1982. the licence is valid from the ....day of .... 198 .... to the...................... day of 198

12. This licence is not transferable.

Secretary to the Govt. of India.

FORM C

[See rule 5 (1) (h) (ii)]

Data on catch of prohibited fish species

1. Name and address of fishing company:
2. Particulars of fishing vessels:

   Name
   Size
   Horse Power of Main Engine:
   Base of operation:
3. Licence Number and period of validity.
4. Description of fishing operations authorised in the licence.
5. Details of fishing gear used:— (a) Length of headline
   (b) Greatest depth.
   (c) Mesh size.
6. Description of the catch.

Sl. No.	Location of the vessel Latitude	Longtitude	Date and Time	Gear in operation	Fishing zone	Depth (Metre)	Species (prohibited)	Average Length (CM)	Average Weight (Kg)	Number
1	2	3	4	5	6	7	8	9	10	11
1.										
2.										
3.										

7. Place of surrendering the catch.
8. Conditions of the catch at the time of surrendering
9. Comments of the Master / Skipper.

Signature of owner / owners representatives

FORM D

[See rule 5 (1) (h) (iv)]

Data on quantity of fish caught in excess of permitted quantum

1. Name and address of fishing company:
2. Particulars of fishing vessels.

   Name:
   Size:
   Horse Power of Main Engine:
   Base of operation:
3. LicenceNumber and period of validity.
4. Description of fishing operations authorised in the licence.
5. Species-wise quantity of fish permitted in the licence (quota)
6. Details of catch particulars.

No.	Location of fishing vessel	Date & Time	Fishing Zone	Length, Depth and mesh size of fishing gear	Species Caught	Raw Weight (Kg.)	Processed products prepared on board the vessel if any	Weight (Kg.)	Total catch (Kg.)
1	2	3	4	5	6	7	8	9	10

7. Details of excess catch

Sl. No.	Location of fishing vessel	Date & Time	Fishing Zone	Depth (Metres)	Species caught in in excess	Average Weight (Kg.)	Average length (cm)	Condition of fish	Reasons for excess catch
1	2	3	4	5	6	7	8	9	10

8. Particulars of excess catch surrendered.

Species	Weight(Kg)	Place of surfrendering	Authority to whom surrendered

9. Remarks of Master/Skipper.

Signature of owner/owners representatives

FORM E

[See Rule 5 (1) (h) (vi)]

Daily Cumulative catch Log

1. Name and address of the fishing company.
2. Particulars of fishing vessels;

   Name:
   Size:
   Horse Power of Main Engine.
   Base of operation:

3. Licence Number and period of validity.
4. Description of fishing operations authorised.
5. Species-wise catch of fish and quantity permitted in the licence.
6. Fishing Area.
7. Date of entry to Indian Exclusive Economic Zone.

S.No.

S.No.	Vessel number	Position	Date & Time	Time of Shooting gear	Time of hauling gear	Hours of fishing	Depth (Metre)	Type of gear
1	2	3	4	5	6	7	8	9

Mesh Size	Species caught	Quantity	Disposition	Cumulative total	Cumulative disposition	Details of transhipment
10	11	12	13	14	15	16

8. Details of Disposition of catch
   Item — Quantity (Kg)
   (a) Consumption:
   (b) Fish gutted:
   (c) Head on (or off):
   (d) Filletted.
   (e) Frozen.
   (f) Canned.
   (g) Fish meal
   (h) Oil.

Signature of owner/owner's representative

FORM F
[See rule 5 (1) (i) (iii)]

Particulars of transhipment

1. Name and address of fishing company.
2. Particulars of fishing vessels.
   Name:
   Size:
   Horse Power of main engine.
   Base of operation.
3. Licence Number and period of validity.
4. Catch and Effort Data:

Area	Species	Number of days fished	Catch (in kg)	Product from vessel

5 Licence Number and side number of vessel receiving transhipment.

6. Position at the time of transhipment:

   Latitude
   Longitude

7. Date of message from vessel:

8. Species and quantities transferred:

Species	Gross weight (kg.)	Value

Signature of own licencee / his representatives

FORM G

[See Rule 5 (1) (j)]

Particulars of processing operations on board the vessel under licence

1. Name and address of fishing company.
2. Particulars of fishing vessels.

   Name
   Size
   Horse Power of main engine.
   Base of operation.

3. Licence Number and period of validity.
4. Description of fishing operations authorised in licence.
5. Name of the port to be used as base.
6. Processing Machinery and Equipment:

Type	Number of Units	Specifications and daily capacity	Percentage utilisation of capacity

8. Storage and holding

Nature of storage	Number of species	Dimensions / volume fish hold

9. Processing details.

Species	Area of Operation	Date of operation	Duration of operation From To	Catch particulars	Products prepared on vessel & quality (Kg.)

(Enter in this column, types of products processed on board the vessel by species, viz: fish gutted, head on (or off) filletted, salted, frozen, caned, meal & oil etc.

10. Position and time of reporting:

    Latitude
    Longitude
    Time
    Date

Signature of owner / owner's representative.

FORM H

[See rule 6 (2)]

Form of Application for 'permit'

Outline Details Required for Proposed Operations

1. Name of the applicant and postal address.

2. Whether the applicant is a registered company under the Companies Act. If so, furnish the following particulars:-

(a) Date and number of Registration and Place.

(b) Authorised, subscribed and paid up share capital.

(c) Attach latest Balance-sheet.

(d) If the company comes under the provision of Monopolies and Restrictive Trade Practices Act, 1969 (54 of 1969), please state whether necessary clearance is available.

3. The foreign collaborator's name, address, Telephone number, Telex number and name of Bankers and their activities in India and in other countries.

4. Present activities of the applicant, if any:

(a) Specified activities undertaken.

(b) Details of fishing vessels / fish processing units and fish export made during the past three years.

(c) Name of all Directors / Chief Executive / Operations Manager / other employees of the Indian Company, their experience in marine fisheries indicating specified fields.

5. Details of the Project proposed to be taken up (enclose project report covering particulars on fishing vessels, anticipated fish production, processing and marketing origanisation management, including financial sources, economics of operation, area and base of opertion, identity of fishery resources to be exploited, catching methods, gear to be employed, etc.)

(a) Type of vessels, type of gear and number of vessels proposed to be chartered (Enclose detailed spacifications and general arrangement drawings and also a full list of machinery and equipment, navigational lights, life saving appliances, fire fighting equipment, inventory items etc.)

(b) Description of the vessel, equipment and crew complement (Enclose certificate given by competent authorities regarding valuation and sea worthiness of the vessels):

(i) Name of the vessel.

(ii) Flag state and home port of vessel.

(iii) Country and port of registration.

(iv) Registration number.

(v) Radio call sign / signal letter / radio frequencies.

(vi) Name of owner and master of the vessel.

(vii) Nationality and address of owner and master.

(viii) Purpose of vessel (kind of vessel).

(ix) Kind of Vessel's hull.

(x) Vessel's year (date of construction and date of launching)

(xi) Number of deck.

(xii) Number of mast.

(xiii) Registered length.

(xiv) Registered breadth.

(xv) Registered depth (draft).

(xvi) Gross tonnage and net tonnage.

(xvii) Fish Hold capacity and refrigeration capacity.

(xviii) Kind of main engine, name and place of main engine manufactured.

(xix) Rated Horse Power of main engine.

(xx) Kind of propeller.

(xxi) Class of eqipments (list).

(xxii) Certified crew capacity.

(xxiii) Service limitations of the vessel.

(xxiv) Name and address of the ship builder.

(xxv) Value of vessel.

(xxvi) Any other remarks.

(c) Number, qualification and experience of foreign crew

(d) Number and names of foreign personnel to be employed ashore.

(e) Enclose authenticated copy of the offer received from foreign collaborator.

6. Duration of charter.

7. Annual rate of charterage or charterage for entire duration.

8. Whether the charterer retains option to purchase vessels after the charter period and terms thereof.

9. Whether the foreign collaborator is willing to assist in export of catches, if so, the terms and conditions.

10. Arrangements for training of Indian-counterparts.

11. Statement of foreign exchange inflow anticipated (excluding payments in foreign exchange out of total earnings by way of exports) for the duration of charter.

12. Total income, total expenditure and net profit anticipated for the duration of charter.

13. Form of charter party proposed to be entered into.

14. Financial arrangements (Describe in detail).

15. Proposals of shore establishment (if any).

(i) Intended location and description of any shore based plant.

(ii) Proposal for registration and date of completion of any shore based plant as a Registered Export Establishment.

(iii) Arrangements for processing catch.

(iv) Estimated annual output of the plant.

(v) Percentage of total catch to be processed and / or exported.

(vi) Export market and marketing arrangements for total catch.

DECLARATION

I / we .... by this declaration subscribed by me / us pursuant to and in compliance with section 5 of the Maritime Zones of India (Regulation of Fishing by Foreign Vessels) Act, 1981, (42 of 1981), fully understand all the provisions of the said Act and Rules and orders issued thereunder and agree to abide by them. I / we .... further declare that the particulars furnished in the above

application are true to the best of my / our knowledge.

Signature of the applicant (s)

FORM I

[See rule 6 (4)]

Government of India

Ministry of Agriculture

Department of Agriculture & Cooperation, New Delhi.

No ....

Dated ....

Permit to Fish in the Exclusive Economic Zone of India

This permit is granted in pursuant to section 5 of the Maritime Zones of India (Regulation of Fishing by Foreign Vessels) Act 1981 (42 of 1981).

2. ....is hereby permitted to use the foreign fishing vessels under charter described hereunder for the purposes specified in paragraph 5 of this permit and in accordance with the conditions set out in paragraphs 8 and 10 of this permit and shall be subject to all the Indian laws that apply to the vessels in the Maritime Zone of India.

3. Description of the vessel

(i) Name of the vessel:
(ii) Type of vessel:
(iii) Country of registration:
(iv) Registration number:
(v) Overall length:
(vi) Gross tonnage;
(vii) International radio call sign and radio frequency:
(viii) Name and address of the master:
(ix) Name and address of the foreign collaborators.

4. Details of charters fee made of payment and any other stipulation.

5. The purposes for which the vessel may be used.

6. Base and area of operation.

7. Period of operation of the vessel.

8. The permit holder shall bound by the terms and conditions specified in rule 8 and the additional conditions / restrictions specified in paragraph 10.

9. Exemptions in the terms and. conditon if any

10. Additional conditons.

11. Name of foreign crew

12. Subject to the provisions of the Maritime Zones of India (Regulation by Foreign Vessel) Rules, 1982, this permit is valid from the ....day of .... 198 .... to the ....day of 198

13. This permit is not transferable.

Dated ....

Secretary of the Govt. of India

FORM J

[See rule 8 (1) (p)]

Voyage-wise Statement to be Furnished by the Charterer.

1. Name and address of the Charterer.

2. Particulars of fishing vessels:
Name
Size Over length
Gross Registered Tonnage.
Horse Power of main engine.
Base of Opertion.

3. Number of crew:
Foreign
Indian.

4. Period of voyage:

(i) Date of departure from foreign port
(ii) Date of entry into the Maritime Zone of India
(iii) Date of reporting at the base of operation.
(iv) Period of fishing From To
(v) Date of departure from the base of operation.
(vi) Date of leaving the Maritime Zone of India.

5. Details of each fishing operation (for each haul)

(i) Haul Number.
(ii) Type and Size of Gear.
(iii) Position Shooting Hauling
Latitude
Longitude
(iv) Time
Shot
Hauled
(v) Depth (metres)
(vi) Total catch (in kilograms)

Maintain species caught Weight (Kilograms)
1.
2.
3.
4.
5.
6.
etc.

6. (i) Value declared at customs for the total catch and for each variety (in foreign currency).

(ii) Value realised on domestic marketing for each variety (in Indian rupees)

7. Quantity, value and country to which each item was exported.

8. Payment made to foreign collaborator:
In foreign exchange.
In Rupees

9. Payment received from foreign collaborator.
In foreign exchange.
In Rupees.

Signature of the Charterer

PROVEN TECHNOLOGY

2. TECHNOLOGY OF CULTURED PEARL PRODUCTION

Highlights: Cultured pearls of good quality are produced in the Indian pearl oyster *Pinctada fucata* by artificially inducing the oyster to secrete mother-of-pearl around an implanted spherical core material produced from shells. The pearl oysters are either produced through artificial breeding in hatchery (see Hatchery Technology of Pearl Oyster Production) or collected from the natural beds by SCUBA - diving. The oysters are grown in an open-sea farm under raft culture, being placed in baskets and suspended at appropriate depths from the floating rafts. Pearl oysters are a minimum one-year old when they are used in surgery and post-operative culture duration ranges from 3-24 months depending on the size of pearls. Multiple implantation technique enhances rate of production. Re-use of oysters for a second crop is possible under certain conditions.

Operational details: The pearl culture farm will have several rafts of 5 m × 5 m size or other dimensions, each constructed using teak poles lashed with ropes and mounted on cylindrical metal barrels to get appropriate buoyancy. The raft is moored by anchors at depths of 5-10 m or more. Pearl oysters are reared in baskets suspended from rafts and when they reach the right size (20-30 g weight) they are taken to the on-shore surgery. Healthy oysters are conditioned using the chemical menthol for operation. Shell-beads of diameter 3-8 mm produced from the shells of conch or other molluscs form the core material or nucleus for implantation. A special set of surgical tools is employed in surgery.

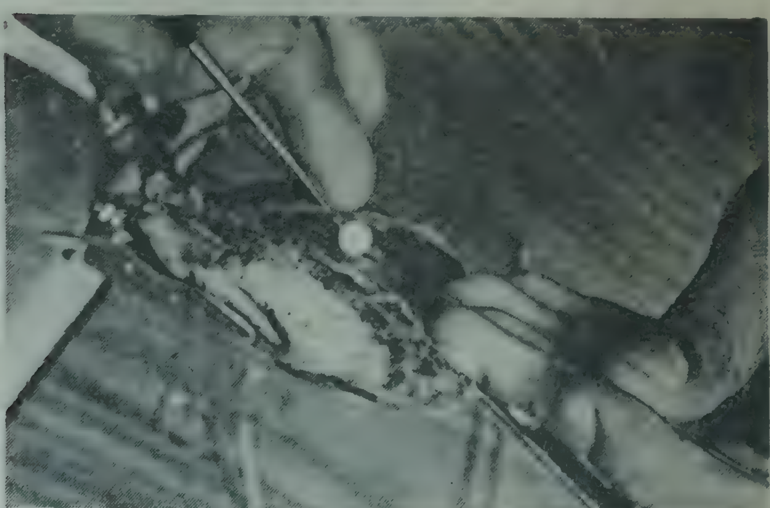


Fig. 1. An aspect of surgery for implantation of shell-bead nucleus in the pearl oyster.

Some oysters are used in preparing the graft tissues of 2-4 mm pieces from the mantles. At the operation, a graft tissue and a nucleus are implanted into the gonad of the oyster. In the case of multiple implantations 2-5 or more nuclei are used at various sites in the body of the oyster. An experienced technician can operate on about 20 oysters per hour. After surgery, the oysters are maintained in the laboratory under gentle flow of seawater for recovery and healing for 3 days. Later the oysters are returned to the farm. The graft tissue grows around the nucleus to form the pearl-sac which then secretes mother - of - pearl (nacre) depositing it on the nucleus. The process continues and when the cultured pearl attains sufficient maturity in terms of lustre, it is ready for harvest.

The rate of rejection of nucleus can be kept within 10% and overall mortality rate within 10% under good conditions. Pearl production rate is around 60% among surviving oysters. Harvest is done by hauling the seeded oysters ashore and opening them for collection of pearls. Sorting of pearls is done under 3 categories, namely grade-A of top quality, B containing medium quality pearls which can be used in jewellery and C containing more or less rejects. A ratio of 30:30:40 of these grades can be obtained under optimum situation.

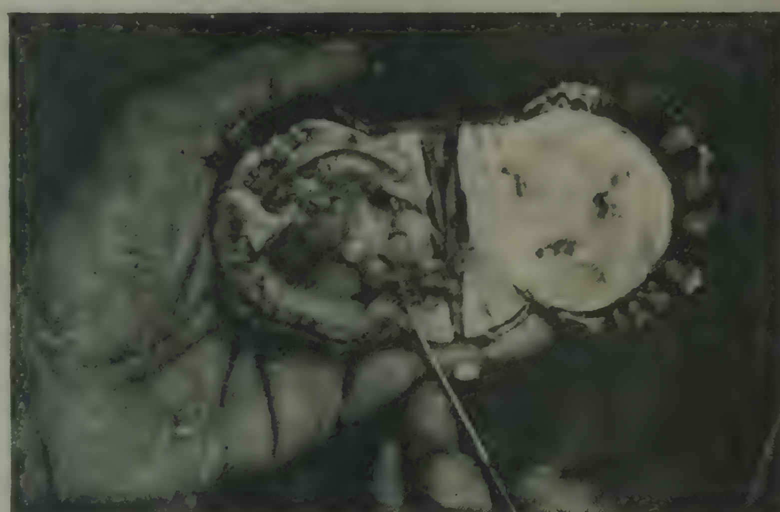


Fig. 2. A cultured pearl produced in the pearl oyster. The tip of needle points towards the pearl.

Production: Pearl culture is an industrial scale operation. The estimated production in a five-year project employing a total of 2 million oysters would be around 1.2 million cultured pearls of Grades A and B. The production would come in stages commencing from about the 6th month after establishment depending on the schedules of surgery and the duration of post-operative culture which would range from 3-24 months. The bye-products of pearl culture are the pearl shells, seed pearls which are incidental and the

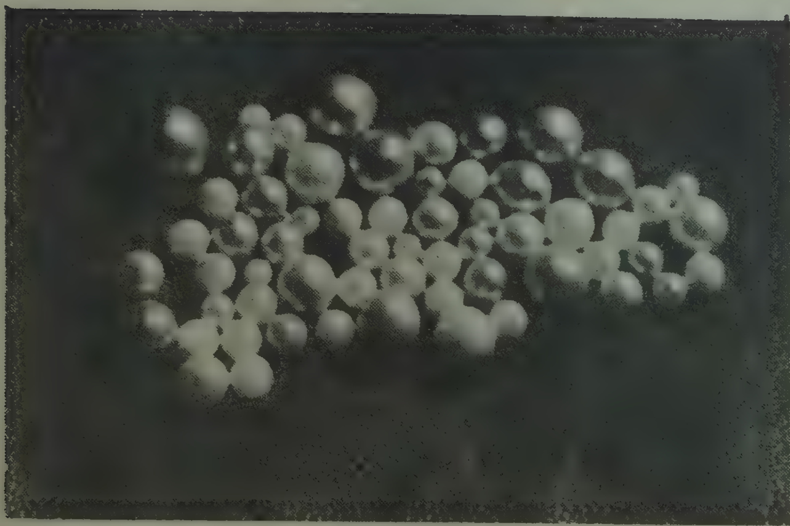


Fig. 3. A batch of cultured pearls of different sizes.

meat. Appropriate technologies for bye - product utilisation are yet to be developed.

Inventory and cost: The capital assets for a 5-year project would be boats, vehicles, SCUBA-diving Units, Compressors and buildings for on-shore work. Expenditure on these would be around Rs.1.5 million. Contingent expenditure on farm structures, shellbeads, instruments, maintenance of boats and vehicles and chemicals and glassware would amount to Rs. 1.7 million. Salary component would be Rs.1.8 million. The total estimated cost of the 5-year project would be Rs. 5 million.

Estimated cost of production: The estimated cost arrived at by certain projections is Rs.4.20 per cultured pearl. Actual cost of production remains to be worked out.

Prospects: India has a good scope for starting a pearl culture industry based on the knowhow available at the Central Marine Fisheries Research Institute (CMFRI). The hatchery production of pearl oysters should be linked up with pearl production which would help in reducing cost of production. The only constraint at present is dependence on imports of shell--bead nuclei. The technology for nucleus production is being developed at CMFRI. Potential areas for setting up pearl culture units for the present would be the Gulf of Mannar along Tamil Nadu coast, Gulf of Kutch along Gujarat coast, as also the Andaman & Nicobar Islands. The world pearl trade has been continuously on the ascent during the last decade and India is a steady importer of cultured pearls. This situation could be changed to the country's advantage when commercial projects are established. The CMFRI can extend the technical knowhow through training programmes at managerial and operative level.

3. TECHNOLOGY FOR HATCHERY PRODUCTION OF PEARL OYSTER

Major highlights: Given the uncertainty resulting from the wide fluctuations of populations of the pearl oyster *Pinctada fucata* in their natural beds in the sea (Gulf of Mannar and Gulf of Kutch), a pearl culture industry in India will have to depend largely on pearl oyster seed produced in hatcheries. Broodstocks are artificially spawned in the hatchery and the larvae are reared in tanks with supplies of appropriate live food. Around day 20, these larvae metamorphose and settle as spat on collectors. They are further reared in nursery tanks upto a size suitable for transplantation to open-sea farm. These young pearl oysters may be supplied to pearl production farms. Availability of good quality sea water and appropriate food would determine the success of spat production.

Operational details: The pearl oyster hatchery has six major functions towards production of spat, namely artificial breeding, larval rearing, spat collection, nursery rearing, microalgal food production and water management. Selected pearl oysters, males and females, are spawned in glass vessels and the eggs are fertilised. The fertilised eggs are transferred to larval rearing tanks and from the early straight-hinge veliger stage, which is reached 24 hours post-fertilisation, the

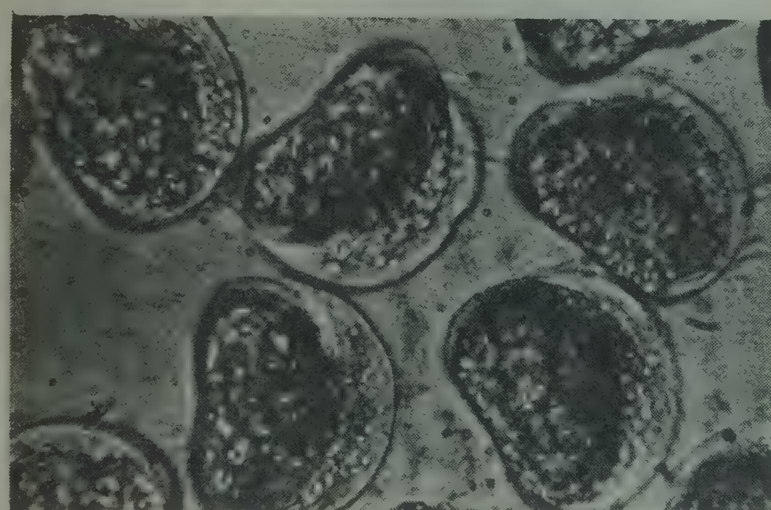


Fig. 1. The straight-hinge veliger larvae of pearl oyster.

larvae are fed with live microalgal forms, particularly *Isochrysis galbana*, which are produced on a large scale in the hatchery. The larval rearing tanks are of 100 litres capacity and larval density ranges 10-20/ml. Seawater filtered to remove particulate matter and treated with ultraviolet light and/or antibiotics to kill bacteria is used in the larval rearing system. Water change is effected on alternate days through careful screening of larvae. Aeration is used to keep the larvae in suspension and to maintain level of dissolved oxygen.

Under good conditions of water quality and feeding (80 – 120 cells/microlitre), the larvae grow progressively through umbo, eye-spot, pediveliger and plantigrade stages before they set as spat around day 20 post-fertilisation. Fibreglass plates of a matty finish are suspended in the setting tanks as spat collectors upon which the spat settle down to begin a sedentary life. The spat, which are as small as 330 micrometers in size, are later reared on a mixed phytoplankton diet in nursery tanks of 500 litre capacity till they reach about 3 mm. Subsequently they are removed from spat collectors, placed in special growing cages and reared in the sea till they reach the "thumbnail" size when they can be supplied to pearl culture farms. The whole hatchery operation would last about four months per batch of spat production.

Fig. 2. Young pearl oysters produced by the hatchery technology.

Production: A hatchery with about 50 larval rearing tanks can yield a production of about 500,000 spat per spawning. In four spawnings a year, an annual production of about 2 million young oysters (thumbnail size) can be obtained from a pearl oyster hatchery.

Inventory and cost: The capital assets of a pearl oyster hatchery would be a semi-permanent hatchery building with laboratories of a total area of about 400 sq. m., larval rearing and nursery tanks, sea water sumps and overhead tanks, air compressors and pumps, and laboratory equipment. The total cost of all capital assets would be about Rs.650,000. Contingent expenditure on glassware, chemicals, U.V. equipment, filters, screens, rafts, cages and broodstock would amount to Rs. 175,000.

Fig. 3. A view of pearl oyster hatchery laboratory at the Tuticorin Research Centre of CMFRI.

Employment and cost: A pearl oyster hatchery for an annual production of about two million spat would provide employment to one scientist (in charge of the project), three technicians (one each for larval rearing, live food production and farm rearing), one mechanic, three supporting staff and two watch & ward staff. The annual cost on salaries would be about Rs.100,000.

Estimated cost of production: The estimated cost of production or the break-even price arrived at by certain estimates is approximately Re 0.22 per spat. Actual cost of production remains to be worked out.

Prospects: Establishment of pearl culture industry in India would to a very great extent depend on hatchery produced pearl oysters. The hatchery can work either as a composite unit of pearl culture or as an independent unit supplying spat, depending on the growth of the industry. The CMFRI can provide training in hatchery technology. The immediate scope would be for a hatchery in the Gulf of Mannar region and another in the Gulf of Kutch region, both areas having a potential for pearl culture.

R.V. SKIPJACK COMMISSIONED

The first fishery research vessel built in India *R.V. Skipjack* has been commissioned and handed over to Central Marine Fisheries Research Institute. The vessel has been designed by AUKRA BRUK A/S, Norway and built at Garden Reach Shipbuilders & Engineers Limited, Calcutta. The vessel was taken over by the Institute at Calcutta.

R.V. Skipjack is a multipurpose steel vessel eqipped for trawling, purse-seining, acoustic surveys, hydrography and marine biological work. The vessel is a Stern Trawler with LMC and of the Lloyds 100 A I class.

Dimensions and particulars

LOA	32.6 m
LPP	28.0 m
Beam	7.4 m
Draught (Loaded)	3.31 m
Depth (Mld)	3.7 m
Speed (Trial)	11 knots
Endurance	15 days

Main Engine

GRW/MAN R8V TLS Marine Diesel Engine 705 BHP at 1600 r.p.m. (DIN 6270 rating), Air starting. Controllable pitch propeller, 1850 mm diameter.

Diesel Generator

2 Nos. with Kirloskar Cummins Engines 192 HP and alternators Jyoti, 160 KVA, 230/415 Volts AC, 3 Phase.

Winches (Hydraulic)

Main winch: Trawl/Purse-seine 13 t hauling capacity-wire 1500 m (20 mm dia.) on each drum. Net winch: 6 t capacity with transport rollers. Topping winch: 1.5 t hoisting capacity Guy winch : 1.5 t hoisting capacity. Cargo winch: 3 t capacity. Hydrographic winch: Auto-spooling with 4000 m 4 mm wire.

Refrigeration

Fish Hold Temperature 34°F (1°C)

Capacities

Fish Hold	115 m^3
Fuel Tank	78 m^3
Lub. Oil	2 t
Fresh Water	12.5 m^3
Fresh Water Generater Capacity	1.5 t/day

Navigational aids

Electrohydraulic Steering
Autopilot-Robertson
Radio Direction finder ADF 5 MK II
Log SAGEM type LHS
Radar Furuno FRS-48

Communication System

SSB Radio telephone SIMRAD PF 3
Intercom-Talk Back and Loud Hailer System (Philips)
S.P. Telephone (ITI)

Acoustic Instrumentation (SIMRAD)

EQ Echosounder 38 kHz
EX Echosounder 50 kHz
Sonar SQ-D 24 kHz
Echo Magnifer MC-100
Trawl eye FH

Laboratory

One laboratory on Main Deck
Operation of Hydrographic/Biological equipments from upper deck Leadsman platform.
Running fresh and sea water facility
Arrangements for live fish tanks on Main Deck

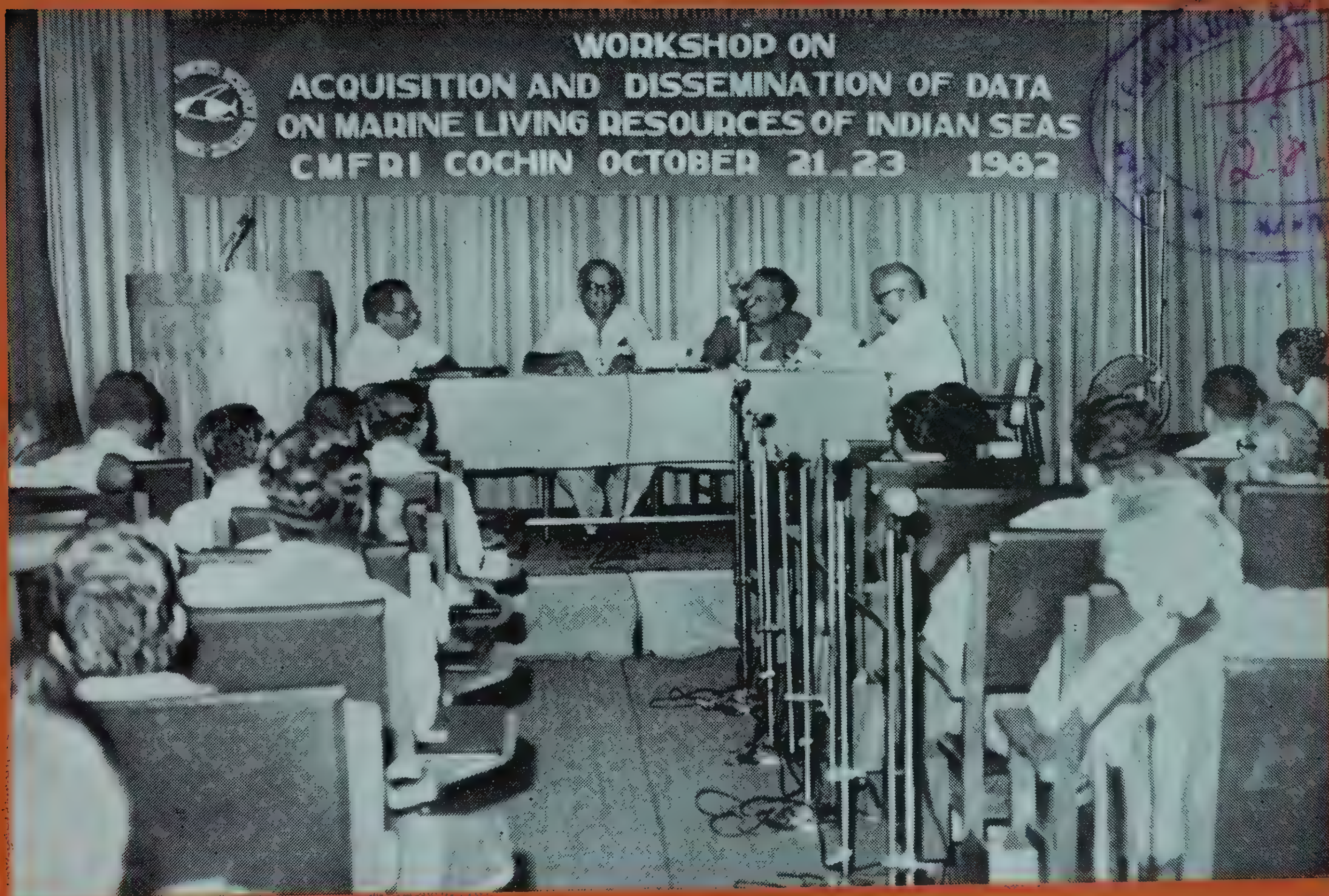
Accommodation

Cabins	7
Baths	2
W-C	2
Ship's Officers & Crew	15 persons
Scientists	4 "

The vessel has reached her operational base at Cochin in December 1982. Research cruises are scheduled to start from early January 1983.

Compiled and prepared by M.J. George, G. Subbaraju and S.K. Dharmaraja.
Published by Dr. M.J. George, Senior Scientist on behalf of the Director, Central Marine Fisheries Research Institute, Cochin-682 018. Phototypeset and printed at PAICO, Cochin 31.

MARINE FISHERIES INFORMATION SERVICE



Technical and Extension Series

No. 46
JANUARY, 1983

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE

COCHIN, INDIA

INDIAN COUNCIL OF AGRICULTURAL RESEARCH

THE MARINE FISHERIES INFORMATION SERVICE: Technical and Extension Series envisages the rapid dissemination of information on marine and brackish water fishery resources and allied data available with the Fishery Data Centre and the Research Divisions of the Institute, results of proven researches for transfer of technology to the fish farmers and industry and of other relevant information needed for Research and Development efforts in the marine fisheries sector.

Abbreviation — *Mar. Fish. Infor. Serv. T & E Ser.*, No. 46 : 1982.

CONTENTS

Proceedings of the workshop on acquisition and dissemination of data on marine living resources of Indian seas.

Cover Photo: View of the plenary session

PROCEEDINGS OF THE WORKSHOP ON ACQUISITION AND DISSEMINATION OF DATA ON MARINE LIVING RESOURCES OF INDIAN SEAS

ORGANISED BY

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE
COCHIN-682 018

OCTOBER 21-23, 1982

PREFACE

Considerable stress has been laid on research and development of marine fisheries in our country since independence and the various schemes formulated by the Government during different plan periods have resulted in an allround progress in this sector. Realising the importance of marine fish catch statistics in the formulation of fishery development plans and management policies, the Central Marine Fisheries Research Institute has been collecting, processing and disseminating data on exploited marine fishery resources over the past three decades. The Institute collects data on biological aspects on a continuous basis for assessment of the fish stocks in the major fisheries and also environmental data for studying interrelationships between different factors. Investigations on the socio economic aspects in the marine fisheries sector as well as impact studies are also undertaken from time to time.

In view of the data base already built up at the Institute, the Planning Commission has identified the Institute for developing the National Data Centre for Marine Fisheries with a computerised information system and suggested that the Institute conduct an All India Workshop on this theme. Accordingly, the Institute organised a National Workshop on "Acquisition and dissemination of data on marine living resources of Indian seas" from 21st to 23rd October 1982 at Cochin.

The objective of the Workshop is to develop proper modalities for the acquisition, processing and dissemination of data on marine living resources as a national facility.

Altogether 52 delegates representing State and Central Government Departments, the fishing industry, Research Institutes and Universities and public and private sector organisations participated in the Workshop. The Workshop discussed in detail the present status of collection of marine fish catch statistics and dissemination of information relating to the same. The Workshop also discussed the problems and prospects in establishing a more viable marine fisheries information system and made several useful recommendations.

The publication contains the proceedings of the workshop and the recommendations. It is hoped that the concerned agencies will give serious consideration for the implementation of the recommendations. CMFRI will maintain close linkage with the various organisations in the task of streamlining the modalities for acquisition and processing of data and dissemination of information in which the cooperation of all agencies is solicited.

E.G. SILAS
Director

PROGRAMME

Session No.		Date	Time
	Registration	21.10.82	9.00 to 10.30 hrs
I	Inaugural Session	21.10.82	10.30 to 11.00 hrs
II	Present status of marine living resources statistics in India	do	11.15 to 13.00 hrs
III	Identification of data requirements of user sectors and standardisation of suitable proformae for collection of data	do	14.30 to 15.15 hrs
IV	Operation of large vessels in the Exclusive Economic Zone	do	15.30 to 16.15 hrs
	Meetings of Working Groups for standardisation of proformae	do 22.10.82	16.30 to 17.30 hrs 9.30 to 11.00 hrs
V	Reports of the Working Groups	do	11.15 to 13.00 hrs
VI	Acquisition and dissemination of data on marine living resources of Indian Seas	do	14.00 to 15.00 hrs
VII	Plenary Session	do	15.15 to 16.30 hrs
	Field trip to Narakkal	23.10.82	07.30 to 12.30 hrs

I. INAUGURAL SESSION

Shri.T.Jacob welcomed the delegates. Dr. E.G. Silas gave the inaugural address

INAUGURAL ADDRESS

As you are aware, fisheries has remained a neglected area as compared to agriculture and livestock. Nevertheless, we have made notable progress during the past 35 years from a mere artisanal activity to an industrial activity. Today we are conscious of the problems and possibilities in fisheries. We talk about the ocean resources, ocean mangement and more so about EEZ under our jurisdiction. There is no denying the fact that we should utilise the resources of this vast area and develop the mechanism for the same. It is gratifying to note that at the policy planning level there is greater awareness that fisheries should be given a better deal. Our fisheries development is in a three tier system. We have the artisanal sector, small mechanised sector and more recently that of large trawlers which are supposed to deliver the goods from the EEZ and the contiguous high seas.

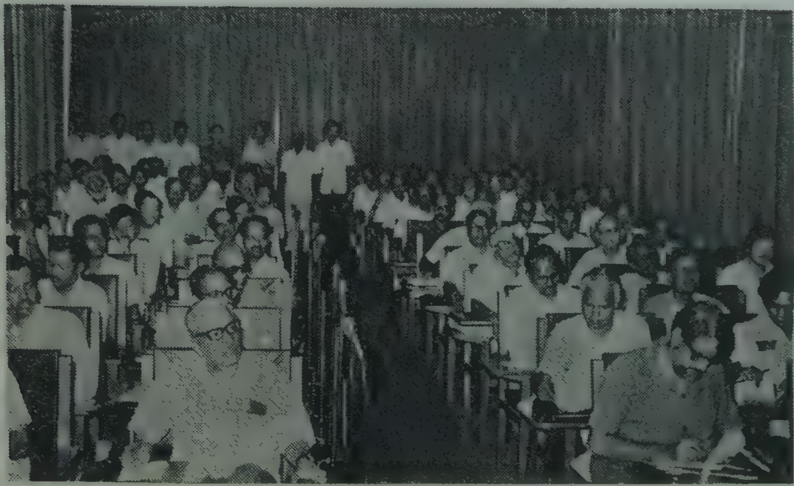
With the introduction of better capture techniques, improved technologies of preservation, processing and storage, discoveries of new fishing grounds, increased utilisation of marine products, development of export markets and implementation of R & D programmes the fisheries sector has emerged as one of the major contributors to the food resources and the national economy. Consequent to this, our marine fish production has gone up from 0.5 million tonnes in early fifties to 1.4 million tonnes in mid seventies. Since then, the catch has more or less stabilised around 1.3 million tonnes and this has focussed attention on the ways and means of augmenting yield by diversification of fishing, utilisation of nonconventional resources and increasing production through coastal aquaculture.

With the declaration of EEZ, greater opportunities and challenges are thrown open to bring in resources hitherto exploited by other countries as well as those unexploited under the national jurisdiction, leading to an eventual increase in the food potential by way of additional catches and in job opportunities in the expanding fishery based industries. Massive inputs and measures by way of introduction of new capture means and development of infrastructure facilities are envisaged. All these call for a continuous and critical study of data pertaining to marine living resources and timely monitoring of information.

The Central Marine Fisheries Research Institute has been functioning as the nodal organisation for the collection, analysis and dissemination of data on marine fisheries and living resources of Indian seas. The Institute developed a stratified multistage probability sampling design to collect information on exploited resources of our multi-species fisheries wherein multiple types of gears are used. Altogether, 90 trained field staff, stationed at 41 centres spread along the coast of India are exclusively engaged in the collection of catch and effort data. This work is carried out throughout the year, and covers about 1,400 landing centres in different maritime states. The field staff are also regularly collecting length frequency data on commercially important species. About 800 species of fish & shell fishes and other living resources of Indian seas have been coded, preparatory to computerisation of these massive data. The present staff is likely to be doubled during the sixth plan period.

About 250 scientific and technical personnel, working at different research centres, are engaged in the collection, processing and analysis of data on various biological aspects such as length, weight, sex and maturity stages of commercially important species and also environmental data. Several case studies on marketing and socio-economic aspects in the marine fisheries sector are being undertaken by the Institute. About 40 scientific and technical personnel are engaged in data processing and analysis. The results of the studies are regularly published in research journals and the Institute's publications.

A policy decision was taken by the Planning Commission at its meeting held on 9.12.'81 presided over by Member (Science) and attended by Advisors of the Planning Commission, Secretaries and Senior Officers of the Department of Agriculture and Co-operation, Additional Secretary of the Department of Expenditure, Director General, ICAR, Directors of Fisheries Institutes and Senior Officers of the Indian Council of Agricultural Research, Director, Department of Ocean Development and Director, National Institute of Oceanography, recommending that there is a need for conducting an All India Workshop on acquisition and



A view of the delegates.

dissemination of data on marine living resources and this should be organised by the Central Marine Fisheries Research Institute (CMFRI) which is the nodal Institute dealing with this subject. Accordingly, the Institute is holding the present Workshop from 21 to 23rd October '82 at Cochin.

The ~~To~~ objective of the workshop is to develop modalities for acquisition and dissemination of data on marine living resources as a national facility. The functions to achieve the objective are:

i) To review the present system of collection, collation, analysis and dissemination of data on marine living resources in the country.

ii) To identify data requirements of R & D, artisanal fishery, fishing industry, aquaculture, development planning and other user sectors.

iii) To standardise various proformae for the collection of data from the artisanal and mechanised sectors, exploratory and research vessels and also from culture fisheries.

iv) To review and develop computerised system for rapid dissemination of information for end users.

Information on the production of marine fish and other living resources is a prerequisite for the formultion of marine living resources development and management programmes. Such information is extensively used by various states and national and international organisations. The data relating to catch and effort as well as biological aspects will enable the estimation of vital parameters like recruitment, growth and mortality, the knowledge of which is essential for rational exploitation of the fish stocks. The resources information thus obtained, will be helpful in farming management policies for exploited fish stocks in the EEZ as well as for other marine living resources like mammals, corals and seaweeds. The data relating to price, marketing and other economic aspects are essential to the Government and industry for evolving suitable investment and finance management policies.

Keeping in view the above, the proposed workshop will assess the data requirements and review the present system of acquisition of data and dissemination of information so as to bring about changes if need be, in standardising and co-ordinating the same.

The sessions today and tomorrow will be deliberating on some aspects which are essential for the proper data acquisition, processing and rapid dissemination in the field of fisheries. We shall also discuss the needs and requirements of the states for strengthening their statistical wings. We are aware that no system of data acquisition will work properly without dialogues with people from whom you expect to get the information. This Workshop is only a beginning. We hope to have in future periodic dialogues with different sectors at different centres so that the entire system of acquisition, data processing and dissemination would be strengthened in the days to come.

Dr.Silas then announced the names of the Chairman and rapporteurs for each session.

SESSION II

THE PRESENT STATUS OF MARINE LIVING RESOURCES STATISTICS IN INDIA

Chairman: Shri V.Ramamurthy, I.A.S.,
Commissioner of Statistics,
Tamil Nadu.

Rapporteurs: 1. Shri P.V.Krishnam Raju,
Deputy Director,
Department of Fisheries,
Andhra Pradesh

2.Dr. K.Alagaraja,
Scientist S-2,
CMFRI,
Cochin

The Chairman emphasising the role of statistics particularly in the fisheries sector, stressed the importance of fish as a protein-source and said we need to have proper data to derive valid conclusions without which statistical analysis, however sophisticated, may not be meaningful. He brought home this important point by citing some interesting examples. He then mentioned the pioneering role played by CMFRI in fish stock assessment studies and stressed upon the urgent need for standardisation of methodology of collection, processing and analysis of data and dissemination of information. The estimates obtained should reflect the reality to the maximum extent possible, as otherwise major policy decisions could go away. He then called for the lead paper of the session to be presented.

MARINE FISHERIES STATIS ICS IN INDIA-PRESENT STATUS*

From time immemorial fishing has been a traditional occupation for a large section of people, inhabiting the sea coast. However, until the turn of the century much attention was not paid to exploit this wealth from the sea which is a perennial source of protein. Unlike other natural resources like minerals, fish is a renewable resource and for healthy growth of the stock, judicious exploitation is a prerequisite.

For formulating developmental plans and evolving policies for rational exploitation of resources, assessment of the exploited stock forms the basis. The data on catch and effort and biological aspects are the essential requirements for assessing the exploited stock. In advanced countries due to the well organised system, statistics of fish landings are readily obtained from the source and are published at regular intervals. However, in India even though of late there has been a spurt in the off-shore and deep-sea fishing sector, where a data retrieval system could be evolved comparatively easily, fishing is till in a developing phase handled to a large extent by artisanal fishermen employing a variety of crafts and tackles. Landings take place all along the coast line in all seasons during day and night. In such a complex structure,collection of landing statistics becomes a formidable task. The cost, operational difficulties and non-sampling errors of a continuous survey covering all the landing centres would be of very high magnitude. A scientifically planned sampling strategy is the only answer to enable estimation of landings by the large number of indigenous and mechanised boats operating in the coastal belt.

1. Estimates of landings of fish from coastal waters

1.1. Historical background

In India the earliest reference to estimates of marine fish catch is traced in the report of marketing of fish in Indian Union. Data were not collected by any scientifically planned surveys but only by trade enquiries and similar evidences.

Soon after its inception in 1947, Central Marine Fisheries Research Institute made attempts to evolve

*Prepared by T.Jacob, K.Alagaraja and K.N.Kurup, Scientists, FRA Division, CMFRI, Cochin and presented by T.Jacob

Dr.E.G.Silas introducing, the Chairman Shri V.Ramamurthy, I.A.S., Commissioner of Statistics, Government of Tamil Nadu.

scientific methods of collecting marine fish catch statistics. In the beginning not much information was available on the marine fishing villages, landing centres, fishing crafts and gears which could form a frame for developing sampling plans. Besides, fishing practices differed from region to region and within regions from season to season. Keeping this in view the Institute conducted a preliminary survey to collect such information as was required for formulating a sampling plan. In the formative years limited resource at the disposal of the Institute was another constraint in conducting large scale surveys. However, an attempt was made as early as 1948 to collect marine fish catch statistics in a planned way.

The entire coastline of india was divided into 12 zones after taking into consideration geographical conditions. In each zone, approximately 400 km long, one assistant was posted and through a rapid survey information collected on fishermen population and crafts and gears.

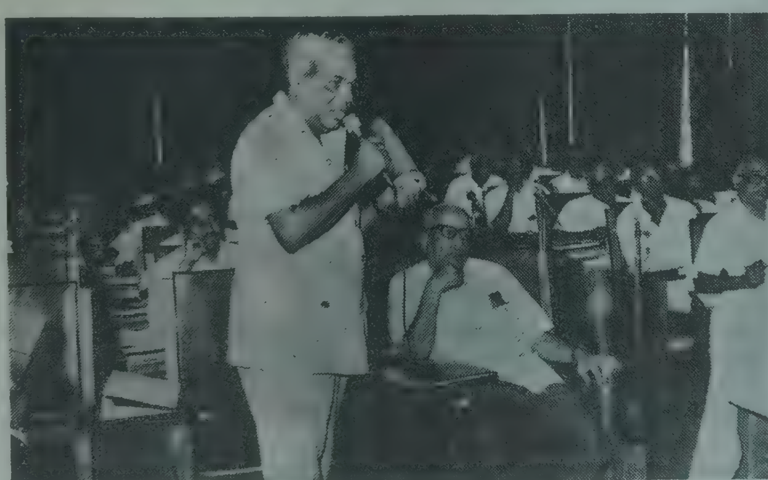
The survey in the beginning was confined to a few important centres and later extended to the entire coastline. Three representative centres were selected from a zone and the selected centres were visited once each in a fortnight. Data were collected from a centre for four to five days consecutively on each visit.

A boat-net combination was taken as a sampling unit. As soon as the enumerator reached the landing centre he would ascertain by local enquiry the number of units gone out for fishing and on its basis he would determine the number of units to be sampled for collecting catch statistics. Five schedules were used for collecting various inventory and production statistics.

All observations were first sorted out as gearwise combinations. In respect of each gear, average catch per operation was worked out. On the basis of daily record the average number of units operated was arrived at. Product of the catch per operation and the daily number of units operated would give estimate of landings by that gear. Similar estimates for all gears added together would give estimated average daily landings.

In the early years, survey programme faced a lot of constraints. Fishermen were reluctant to co-operate with the scheme thinking that the survey was meant to assess their income from their traditional occupation. Many of the landing centres were not easily accessible due to lack of conveyance and road. Allotment of funds towards survey was very much inadequate to facilitate good coverage. With the provision of additional funds, survey programme was considerable expanded in 1957 and the number of zones was increased from 12 to 20, thus expanding the coverage.

Pilot survey was first undertaken along 160 km coast line of erstwhile Malabar. 61 landing centres were grouped into 12 geographical strata. Three-stage stratified sampling design was followed. A landing centre, time interval of 20 minutes and fishing unit formed first, second and third stage units. One centre was selected from each stratum and was kept under observation for one week. Within a day, data were recorded for 14 hours from 05.00 hrs to 19.00 hrs. An hour was divided into 3 intervals of 20 minutes each. One of such intervals which was the same for all hours of the day was devoted for counting the number of units landed during that interval while for recording catch the first unit landed during the remaining two intervals put together was taken. Product of the estimated total number of units operated during the period and the average catch per unit of operation gave estimate of total catch during the period.



Commodore K.M.V.Nair participating in the discussions.

Similar surveys with varying details were carried out in subsequent years along erstwhile Travancore-Cochin coast, erstwhile Madras coast, Andhra coast, Canara coast and Bombay coast.

The CMFRI initiated collection of marine fish catch statistics through a multi-stage stratified probability sampling design in the west coast of India in 1959. This was subsequently extended to the entire coast in the following years. Vast experience gained by the Institute in the collection of marine fish catch statistics and the results of the pilot surveys conducted by ICAR have gone a long way in the development of the sampling design currently followed by the Institute.

Prof. S.L.Shanbhogue, Fisheries College, Mangalore, participating in the discussions.

1.2. Current procedure followed by CMFRI

A brief outline of the design is as follows:

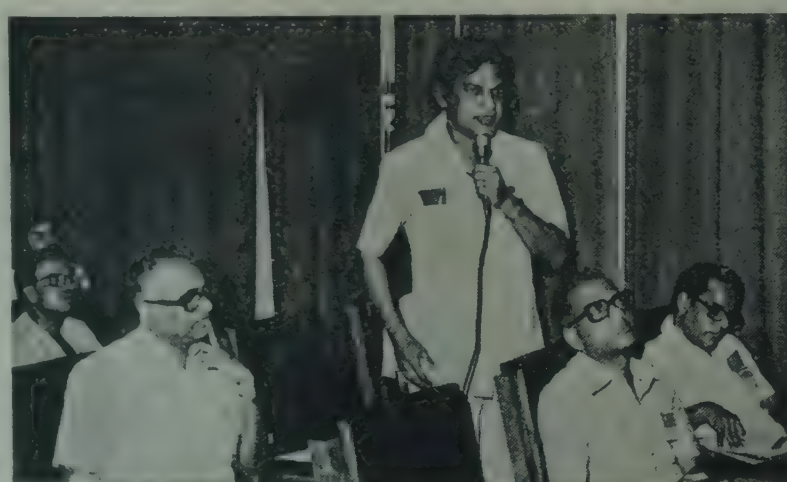
The design is one of the stratified multistage random sampling, the stratification being over space and time. Each maritime state is divided into several zones on the basis of fishing practices and geographical considerations. A zone is a stratum over space and a calender month over time.

Nine landing centres are selected randomly from a zone. A month is divided into three groups of ten consecutive days. From the first ten day group one day is selected at random from the first five days. Then six consecutive days from the selected day onwards are considered and these six days are grouped into three clusters of two consecutive days each. From second and third groups of ten days three clusters each of two days, are selected systematically with a sampling interval of ten days. These nine clusters are alloted to the nine selected landing centres.

On the first day of observation, data are collected from 12 to 18 hours and the next day from 6 to 12 hours. Data on night landings are obtained by enquiry covering the period between 18 hours of the first day and 6 hours of the next day. Thus a 24 hour period is covered. This forms what is termed as a landing centre day. This is the first stage sampling unit. On the day of observation at the selected centre, if the total number of units landing is ten or less, all the units are observed. When it exceeds ten, depending upon the total number of boats landing, a sample of boats is selected in a predetermined manner. The fishing units form the second stage units on which data on species - wise catch, effort, types of crafts and gears operated and nature of fishing ground are collected. At the third stage, samples of commercially important species are taken for biological observations.

Based on the information from the selected fishing units, the total landings for the observation period are estimated. By adding such estimates for two six hour period along with night landings, if any, the estimates for a landing centre day are obtained. From these, the monthly estimates for each year on zonal, district and state basis are worked out. Estimates have sampling errors between 4 and 5 percent in respect of annual landings for the country.

The design currently followed differs in details from the designs first implemented in different maritime states of the country. Thus, in Kerala for example a centre - two day group was the primary sampling unit. A day was divided into 4 intervals of 3 hours each as 06 - 09 hours, 09 - 12 hours, 12 - 15 hours and 15 - 18 hours. On the first day in each centre, observations were made during two intervals 09 - 12 hours and 15 - 18 hours and on the second day remaining intervals namely 06-09 hours and 12-15 hours were deveted for observation. Similarly in the east coast, primary sampling unit was again, a centre - two day group while within a day no sampling was done over time. Observations were taken through out the day ie. from 06 - 18 hours. Stratification also underwent periodic changes in order to cope up with the changing fishery conditions.



Shri M.Swaminath, Director, CIFNET, participating in the discussions.

From late fifties onwards due weightage was given in the survey programme to include landings from mechanised sector. Estimates of mechanised landings

at some important centres like Sassoon Dock and Versova in Maharashtra and Mandapam in Tamil Nadu were separately arrived at. Progressively this system was extended to some more important centres like Fort Cochin, Munambam and Sakthikulangara, in Kerala and Waltair in Andhra Pradesh.

In the early seventies, there was a spurt in the implementation of mechanisation in the fishing industry, with the result the quantum of data to be collected increased tremendously. The Institute took timely action to give due weightage in covering such centres with suitable modification in the plan and increasing the staff strength. Some of the centres rose to prominence due to heavy fishing acitivities and increased harbour facilities. The concept of single centre zone was developed in this context and today there are 24 such zones.

Introduction of purse seiners in Karnataka and Goa in recent years and of late in Kerala has been a challenge to those responsible for collecting fish catch statistics. Fishing is intensive and the fish caught are by and large transported to the landing centre through carrier boats. Sometimes the mother boats also land the catches. Here again suitable innovations were made in the sampling strategy so as to take care the special features of this fishery.

From 1950 onwards CMFRI has been publishing annual marine fish landings with state-wise and variety-wise composition.

1.3. Statistics collected by State Departments

Fisheries Departments in various maritime states also have been collecting statistics on marine fish landings. States like Maharashtra Gujarat and Tamil Nadu are collecting statistics as per sampling designs either same or similar to that followed by CMFRI. In Maharashtra the main difference is that the centres are selected with probability proportional to size (average catch of previous three years). In some states statistics are collected through Department staff who visit fixed centres and collect the data through enumeration.

Frequent dialogues are made between the representatives of State Departments and CMFRI to examine the estimates and attempts are made to arrive at combined estimates.

2. Frame Survey

The information base on the potentialities of man power involvement, the number of fishing crafts and gears and infrastructure facilities such as fishing harbours, landing jetties, ice plants and cold storage-cum-freezing plants available in the coast of India is a prerequisite for planning developmental programmes in marine fisheries. This also provides the frame for conducting sample survey for the estimation of marine fish production and fishing effort in India. In order to understand the status of the traditional small scale fisheries sector in the changing pattern of fishing industry, periodic frame surveys for estimation of these parameters are vital. Keeping these in view the Institute has been conducting frame surveys at regular intervals ever since 1948-49.

Besides, the National Commission on Agriculture has emphasised in its recommendation that Central Marine Fisheries Research Institute should conduct quinquennial census in order to update the inventory of fishing resources available in the coastal villages with the help of State Governments. This gave a fillip for the Institute to undertake in a short interval an intensive census on a massive scale during May-July 1980.

The major items covered in the survey were family size, educational status, number of active fishermen, number engaged in associated fishing activities, number of mechanised and non mechanised fishing crafts and gears, type of ownership, number of fishermen engaged in aquaculture practices and information on fisheries harbours,landing jetties, transport facilities, number of boat building and repairing yards, cold storages, freezing plants, fish curing yards, peeling sheds, banks and fisherman co-operative societies. The results are published by the Institute from time to time.

Directorate of Economics and Statistics of Department of Agriculture, Govt. of India organises quinquennial live stock census in collaboration with state departments. In this census, information on marine fishermen population crafts and gears available and allied items is collected and published periodically.

3. Fishery economics data

Economic studies in relation to structural changes, production, cost and market research are required to arrive at suitable policies for the management of fisheries taking into consideration physical as well as social benefits. CMFRI has initiated several investigations to collect data on socio - economic conditions of fishermen, impact of introduction of new technologies, economics of fishing operations and behaviour of market mechanisms. Some of the Universities and Research Organisations also collect fishery economics data mostly location based.

4. Data from large mechanised vessels

Apart from the data collected through the sample

surveys, landings by larger mechanised vessels owned by Govt. of India were made available by the organisations like Exploratory Fisheries Project, Integrated Fisheries Project and Central Institute of Fisheries Nautical and Engineering Training and these were incorporated in the estimates prepared by the Institute.

Only very limited data are available on catch by larger trawlers owned by private industry. In the immediate future fishing industry is going to be triggered to exploit the declared Exclusive Economic Zone. The number of large vessels including those coming under charter agreements operating in this zone is going to increase manyfold and quite a lot of useful fishery data would be occuruing. Modalities to acquire such data and monitor the processed results have to be developed. Such information is essentially required for framing suitable policies for management of the exploited fishery resources.

A note on "Present status of acquisition and dissemination of marine fisheries data in Andhra Pradesh" prepared by Shri P.V.Krishna Raju was circulated to the delegates.

Discussion

After the presentation of the paper the Chairman invited the views of the delegates.

Commodore K.M.V. Nair wanted to know whether the estimates obtained by CMFRI were checked by any other system such as by way of complete enumeration at selected landing centres and whether the CMFRI had evolved any system to collect data relating to culture fisheries particularly in brackish waters. Replying, Shri T.Jacob said that periodic supervisions and checks of survey work are conducted to reduce non-sampling errors and the standard error of estimates of total catch were only 4 to 5%. Intensive coverage is also done in the case of important fish landing centres, such as Sakthikulangara (Kerala), Cochin Fisheries Harbour and the Sassoon Dock in Bombay. Intervening, the Chairman suggested that one of the centres may be selected for monitoring the landings all the days in the year, which was agreeable to Dr.Silas. Shri.R.Sathiarajan recalled his past experience in collection of data on marine fish landings in Tamil Nadu and stated that estimates of CMFRI closely agreed with those of the State Government.

Dr.A.A.Rama Sastry pointed out the importance of advance warnings on weather conditions in reducing the risks of fishermen going for fishing. For this purpose two units of the I.M.D. were in operation - one in Tamil Nadu and the other in West Bengal- to acquaint fisherfolk about sea going risks as these developed. The Chairman observed that All India Radio issues weather bulletins received from the I.M.D. and in the districts the revenue and fisheries officials also take suitable measures to warn the people. He mentioned that sustained and well designed propaganda measures should be developed bringing home the advantages of taking note of weather warnings and the great loss caused by ignoring them.

Dr.S.L.Shanbhogue, mentioned that wide variations existed between the estimates of State Fisheries Department of Karnataka and CMFRI on marine fish landings in Karnataka. Shri B.V.Subramanyan indicated that difference in these estimates were sometimes evident and claimed that Karnataka state was collecting the data on complete enumeration basis and this data suited the department. Shri Jacob stated that cent percent enumeraion did not seem practicable and it was difficult to make comparisons between the data collected by the State and CMFRI data. In earlier meetings the Director of Fisheries of Karnataka State had been appraised of this situation and he had agreed to try the CMFRI sampling design. The Chairman suggested that the State Fishereis Department of Karnataka may select any one centre and collect data by using the sampling method of CMFRI and compare the figures so obtained with their "full enumeration" data.

Shri K.Krishna Rao mentioned that if CMFRI furnish data on catch and effort details for different boat-net combinations it would be useful and also suggested that collection of data on disposition of catches along with catch details may be attempted. Shri Jacob replied that computerisation would help in supplying information in whatever form required and that at present CMFRI was furnishing gear-wise catch details. Regarding the disposition of catches he mentioned that this work would be taken up in due course by the new Fishery Economics and Extension Division.

Shri J.D.Mhaiskar explained that on the basis of the sampling design given by the Bureau of Economics and Statistics of Mahrashtra, his Department was obtaining species-wise and gear-wise data. He also mentioned that data on utilistion of fish, and fishing effort were also collected and the catch estimates were found to show more or less similiar trend as those of CMFRI. At the end of every year, a reconciliation of estimates was being carried out with CMFRI and the reconciled estimates furnished to the Government of India and other agencies. Shri Jacob expressed that it was desirable to collect data by two agencies and this would help to have a cross check.

Shri. R.Srinivasan mentioned the existence of three agencies in Tamil Nadu viz. Department of Statistics, Department of Fisheries and CMFRI, collecting data on marine fish landings. However, these estimates did not differ much, he added.

Regarding supply of data on financial year basis Shri Jacob mentioned that the same will be furnished in addition to estimates on calendar year basis. Shri K.V.N.Rao suggested that the season-wise break of estimates would be useful. It was agreed that quarter-wise information would meet the requirements. Shri Mhaiskar stated that Maharashtra supplies information quarter-wise and furnished annual estimates for the fishing year reckoned from July to June. Dr.Rama Sastry suggested maintenance of daily data on magnetic tapes which would help to retrieve data in whatever form and combination needed.

Shri M.Swaminath wanted to know the system adopted by CMFRI for market survey especially with reference to the domestic market. Shri Jacob replied that already data were being collected to study the price-spread for fish at certain selected centres like Sakthikulangara and Cochin Fisheries Harbour. Trying to find a reason for the downward trend in fish landings, Shri Sathiarajan suggested that this may be due to concentration of fishing effort in search of prawns which yield higher prices. The Chairman said that a properly weighted index was desirable and that CMFRI may take up a programme to construct one and study the trends which was accepted by Shri Jacob. Dr.P.V.Rao suggested that this workshop might indicate methods to arrive at a single estimate instead of different sets of estimates given by different agencies.

Shri V.Ramalingam, agreeing with the view of Dr.Rao, expressed the difficulties MPEDA experienced with different sets of figures furnished by different agencies and suggested that estimates furnished by CMFRI may be utilised for all purposes as they are based on scientific sampling design.

Dr.Rama Sastry proposed that after studying the variations and the trends, CMFRI may increase the sample size by utilising the services of State Government Departments.

Concluding the session, the Chairman remarked that the objectives with which surveys are designed and conducted should always be borne in mind throughout the process of collecting, compiling, analysing and interpreting data, so as to make the estimates meaningful. He suggested that uniform design in sampling should be adopted by CMFRI and State departments. He thanked the participants for making the session successful and hoped the Workshop as a whole would contribute towards a better awareness of responsibility in compiling and using data, particularly so in a vital area like that of fisheries.

SESSION III

IDENTIFICATION OF DATA REQUIREMENTS OF USER SECTORS AND STANDARDISATION OF SUITABLE PROFORMAE FOR COLLECTION OF DATA

Chairman: Dr.A.A.Rama Sastry,
Deputy Director General,
India Meteorological Department,
Pune.

Rapporteurs: 1. Dr.S.L.Shanbhogue,
Professor, Fisheries College, Mangalore.

2. Shri K.N.Kurup,
Scientist S-1, CMFRI, Cochin

The Chairman in his introductory remarks said that CMFRI has been the pioneer Institute collecting data on living resources of the Indian Seas. A lot of data are available and the methods to improve the availability of such data might be discussed. This Workshop could also discuss the format in which the data are to be collected. Users could be from various disciplines and data requirements could cover wider fields than for which they are generated. Appropriate formats could be developed so that various end users can use the data without difficulty. He then invited Shri S.K. Dharmaraja to present the lead paper.

DATA NEEDS OF USER SECTORS AND AN OVERVIEW OF THE PROFORMAE*

For the assessment of various fish stocks, their judicial exploitation and formulating fishery management policies, the data on catch and effort are essentially required. The various financial bodies, planning organisations and fishing industry also need the data for their developmental plans. The different Departments of Government of India, State Governments, the Marine Products Export Development Authority and the research organisations look for the data for their administrative and other requirements.

Fish stocks are exploited by both indigenous as well as small and large mechanised crafts using various types of gears. In order to collect data from the above categories of crafts and to meet the requirements of the user sectors a number of proformae have been devised for consideration of the Working Groups. These proformae are briefly described here.

1. Indigenous fishing crafts.

The proformae for indigenous fishing boats operated during the period of observation, the number of crafts sampled, the types of crafts and gears used, mesh size, man power employed, duration of actual fishing, number of hauls, distance of the fishing ground, depth, departure and arrival time of fishing crafts, species-wise composition of total catch of each sampled boat and also price statistics of important fishes at landing centres. The environmental factors like state of sea, sky, direction of wind and current have also been added in the proforma.

2. Small mechanised fishing crafts.

In the proforma for the collection of data on catch and fishing effort from small mechanised boats the items of data to be recorded are more or less the same as for the indigenous boats except for the additional data to be collected on length of boat and horse power. The proforma is meant for collecting data from trawlers, gillnetters, long liners, dolnetters and motorised boats using gears like boat seine, gill nets and hooks and lines. In respect of purse-seiners, however, as the effort data are difficult to collect from the landing boats which are mostly carrier boats, additional proforma has been devised to collect effort data by enquiry from the operators of purse-seiners.

3. Larger mechanised vessels

Proformae for trawlers, purse-seiners and tuna long liners have been prepared for the collection of catch and effort data as also additional information on environmental factors and data pertaining to other related items.

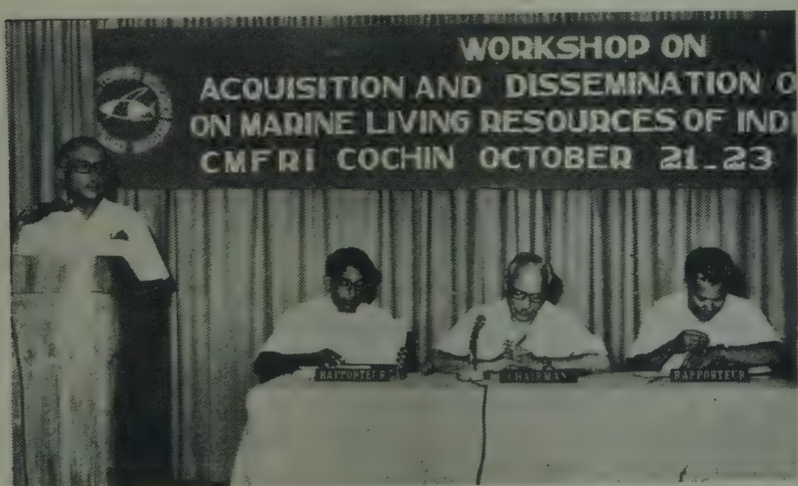
*Prepared by S.K.Dharmaraja, K.Balan and K.Vijayalakshmi, Scientists, FRA Division, CMFRI, Cochin and presented by S.K.Dharmaraja.

a. Trawlers

For trawlers, the items to be recorded are name / code of vessel, voyage particulars, method of fishing, base of operation, date and day of trip as basic data. The other items to be furnished have been divided into 3 major groups viz., fishing conditions, catch details and special observations. The particulars such as fishing area (latitude & longitude), trawling speed, direction of trawling, mesh size, time of trawling, both fishing and bottom depths, sea conditions and current directions are to be recorded under the item fishing conditions.

The catch particulars of differnt species as listed in the proforma are to be furnished under the column – catch details. Special observations, such as wrecks & obstructions, presence of foreign vessel, sighting of whales and dolphins, fish shoals etc as required under item C of the proformae are to be also filled.

The above particulars are required for studying the interrelationship of catch and environmental factors.



Dr.E.G.Silas introducing the Chairman Session III Dr.A.A.Rama Sastry, Deputy Director General, I.M.D.

b. Purse-seiners.

For recording the data on catch, effort and other particulars separate proforma has been drawn for purse-seiners. Under fishing conditions, particulars like size of net, detection-visual/sonar/bird flock, type of school and size, scouting time, time of setting and finish, thermocline top and bottom depth have been included.

C. Tuna long liners.

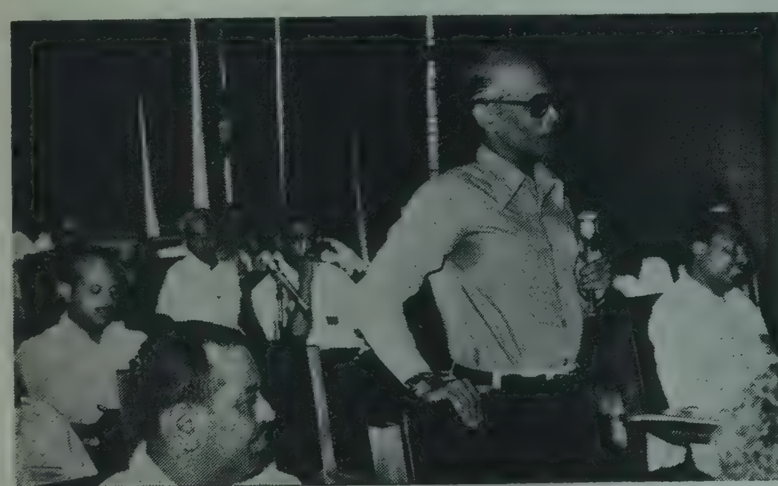
The proforma for the tuna long liner has got two broad categories of information such as hydrographic data and fishing data. Under hydrographic data, items such as position (latitude & longitude), depth range of operation, bottom depth, directions and speed of wind and current, air and sea surface temperature, top and bottom depth thermocline, sea conditions such as wave direction, scale and water transparency are to be recorded.

Under fishery data, particulars like fishing area, no. of baskets, total number of hooks, baits shooting direction, hours hauling, catch composition of fishes in terms of numbers as well as weight are to be recorded.

Discussion

Commodore Nair wanted clarification of the term larger vessels and asked whether the proformae were meant only for commercial vessels or whether they were meant for those owned by Government of India. Dr.Silas clarified that vessels of size above 17.3 m are denoted by the term larger vessels and said that the proformae are intended for all vessels.

He further stated that proformae have been distributed before Working Groups met, in order to stimulate a prethinking and the resultant individual views on various items discussed.



Shri K.H.Mohamed, Scientist S-3 CMFRI, participating in the discussions.

The Chairman remarked that the information collected through the proformae is of diverse nature and could form cross references for end users. He suggested that some of the items which require high scientific skill at the level of collection may be delinked from the main schedule and may be collected through separate schedules. Shri.K.V.N.Rao remarked that apart from hydrographic data, environmental data like current and wind directions and bottom condition would help in understanding the physical characteristics of the fishing grounds and may be of much help to the fishing industry. Commodore Nair also subscribed to the need for collecting such information and suggested that the same should be disseminated at the fishermen level in the form of charts, atlases etc. The Chairman remarked that some information which are qualitati-

vely known can be supplied to fishermen. Data which are to be collected by scientifically designed methods could be obtained separately. Dr.Silas said that skippers also make some valuable observations which are important. Information on wind as a source of energy is of much importance. Data on thermocline are required for effective fishing of tuna by purse seiners. Shri Ramamurthy was of opinion that an environmental awareness on the part of fishermen is always desirable and hence in this respect such data would help in a long way. Dr.C.Hridayanathan suggested that details regarding winch may also be included in the proformae. Lt.A.J.Lucose remarked that information on current, wind etc. are available already in navigational charts. However, it is desirable that maximum data are collected by vessels operating in various areas and the data are made available at a central place so that other agencies can obtain them.

The Chairman in his concluding remarks said that it should be ensured that the data collected are accurate and reliable. It is desirable that all data are accompanied by a note giving its accuracy and limitations.

SESSION IV

OPERATION OF LARGE VESSELS IN EXCLUSIVE ECONOMIC ZONE

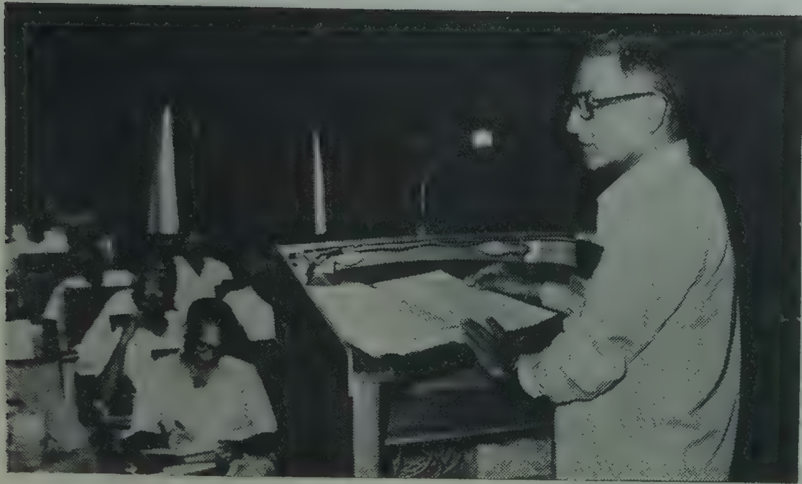
Chairman: Shri R.Sathiarajan, Director, I.F.P., Cochin.

Rapporteurs: 1. Dr. M.Deveraj, Professor, Central Institute of Fisheries Education, Bombay. — 2. Shri. K.Balan, Scientist S-1,. CMFRI, Cochin.

In his opening remarks, the Chairman stressed the importance of 'Charter Policy' of the Government of India in the development of fisheries including the training of personnel in the operations of fishing vessels. He then invited Shri B.B.Lal to present the views of Government of India in respect of the policy on Chartered Vessels.

Shri Lal, briefly outlined the 'Charter Policy' of the Government of India. He stated that although the country has formulated its charter policy soon after the declaration of the EEZ, there has been many areas which needed further improvement. He mentioned that in the current policy, there are about 30 terms and conditions which a company chartering foreign fishing vessels is required to comply with. They include major items like (1) the company should have a minimum capital of Rs.5 lakhs (2) the strength of the Indian crew on the chartered vessel should be at least 20% of the total crew (3) the foreign crew will be allowed to be employed only after due concurrence of the Government (4) there is a basic requirement on the part of the foreign counterparts to train the Indian crew on the fishing techniques employed by the chartered vessel (5) initially the charter would be for three years, but could be extended further depending on individual merits, (6) one applicant wil be allowed to operate only 5 vessels for one particular type of fishing but this condition is not binding on the State Fisheries Corporations, Fishermen cooperatives, State Fisheries Departments and the public sector undertakings (7) the company shall provide bank guarantee for Rs.2 lakhs and pay a licence fee of Rs.10,000 per vessel per annum (8) the chartered vessels will not engage themselves in oceanographic sureys of any kind in the territorial waters or for that matter in any part of the EEZ (9) the chartered vessels should allow Indian Scientists on board and facilitate collection of scientific data (10) the vessels shall call back to the ports once in 30 days (11) they should engage themselves in fishing for which they are authorised (12) all data on fishing, catch, effort and economics including export earnings shall be furnished to the Government and (13) violation and lack of compliance with the conditions may even entail cancellation of the licence. Shri Lal added that the present policy aims at providing maximum encouragement to the entrepreneurs in the fisheries sector in the operation of chartered vessels.

The Chairman thanked the speaker for his brief and effective presentation of the charter policy. He remarked that apart from many conditions and clauses in the charter policy, there are two major aspects in the policy namely scientific aspect and defence aspect which require careful considertions.



Shri B.B.Lal, Asst. Commissioner Fisheries (Statistics), Department of Agriculture, New Delhi, explaining the 'Charter Policy'.

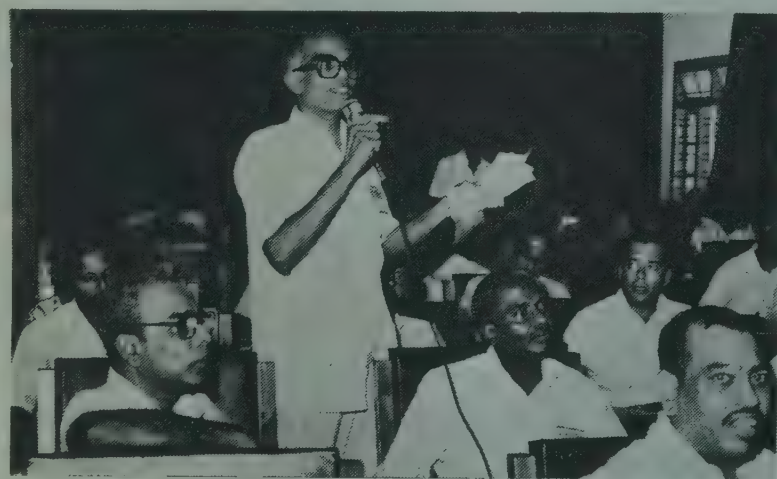
Opening the discussion on the topic, Commodore Nair mentioned that no Indian understudy for skipper is posted in any of the chartered vessels. Inspite of the fact that both pair and bull trawling are going on for the last 8 months or so, there has not been any data coming forth to the national agency resulting in a tremendous loss of very valuable data. It was also pointed out that scientists have also not gone on board in any of these vessels. Even in respect of the Indian crew participation, in many cases it is found to be very negligible. The vessels seldom report their position in the sea. Shri B.B.Lal reported that the Ministry of Agriculture is setting up a cell to monitor the effective implementation of the Charter Act. The Chairman did not agree with some of the points raised by Commodore Nair. He pointed out that data sheets of the chartered vessels are passed on to the Ministry and there is no difficulty to pass them further on to CMFRI. In at least 2 of the vessels, for which he has first-hand information, there are 4 Indian crew each a Skipper trainee, an Engineer trainee and two Deckhand trainees against 16 foreign crew. However, he did not have any information in respect of scientists' participation and any existing deficiency could be rectified. If there is a violation to the requirement of position reporting, it should be seen that this practice is not continued any more. He hoped that the Ministry representative will take care of all these aspects.

Shri K.V.N.Rao suggested that log sheets may be handed over to the representatives of the National data agency when the vessels call on the ports. He also suggested that the coast guard could inspect the vessels and see whether the terms and conditions are fully complied with.

The Chairman mentioned that in cases of vessel endurance exceeding 30 days, there should be provision to allow port calls according to endurance. He also said that occasionally naval vessls do visit and monitor the performance of the vessels in sea. Shri V.Ramamoorthy suggested strict enforcement of legal provisions incase of any violation of conditions under Charter agreement.

Shri P.Sulochanan indicated that the chartered vessels should have their names in a language (English or Hindi) easily comprehensible to the Indian authority. Shri Lal said that this is one of the terms of the Charter policy and the company is obliged to comply with it. Commodore Nair suggested that the best mechanism of collection of information is through the Indian crew. Communications between vessels are very difficult since the Government conditions are so very stringent on this matter.

Shri K.H.Mohamed wanted to know whether there has been any specific case of chartered vessel violating the Government conditions and due punishment accorded. Shri Lal replied that he was not aware of such violations.



Dr.K.Alagaraja, Scientist S-2 CMFRI, participating in the discussions.

Dr.P.V.Rao enquired whether there is any constraint being experienced by the Government for data acquisition. The Chairman replied that data are regularly coming forth, but there is as yet no mechanism for checking the validity of the same. Commodore Nair supplemented that the fishing vessels are not provided with any proformae and the understudy (who should preferably be a qualified skipper) should be in charge of data collection.

Mr.R.Sreenivasan wondered why there should be any restriction of a particular mode of fishing to just 5 vessels for each company. This is particularly a restraining factor when viewed against the Government target of 350 deep sea vessels by the end of the Sixth Five Year Plan.

Shri Lal mentioned that of the 36 applications received so far for charter, 19 have been cleared. The other applications have not yet been cleared for the

reason that they have not yet been able to execute the proper documents. Regarding the restrictions of 5 vessels for the one type of fishing by each company, the Chairman remarked that this was meant to encourage diversification of fishing.

The Chairman concluded the session by thanking the delegates for their active participation in the discussion.

SESSION V

STANDARDISATION OF PROFORMAE

Chairman: Commodore K.M.V.Nair,
Tata Oil Mills, Madras.

Rapporteurs: 1. Shri V.Ramalingam, Joint Director, MPEDA, Cochin.
2. Shri T.Jacob, Scientist S-3, CMFRI, Cochin.

In order to standardise the proformae for collection of data from nonmechanised boats, small mechanised boats and larger vessels(more than 17.3m),draft proformae developed by Central Marine Fisheries Research Institute were entrusted with 3 working groups of the delegates under the following leadership for each group.

Group	Group Leader	Member Secretary
1. Non-mechanised boats	Shri R.Srinivasan, Joint Director, Fisheries Department, Tamil Nadu.	G.Venkataraman, Scientist S-3, CMFR Institute, Cochin.
2. Small mechanised boats	Shri V.Ramamurthy I.A.S., Commissioner of Statistics Tamil Nadu.	Dr.K.Alagaraja, Scientist S-2, CMFR Institute, Cochin.
3.Large vessels	Commodore K.M.V.Nair, Tata Oil Mills, Madras.	Shri T.Jacob, Scientist S-3, CMFR Institute, Cochin

The Working Groups had their deliberations from 21.10.1982 evening to 22.10.1982 morning 11 A.M. The reports of these Working Groups (Appendix 1) were considered at this Session

The Chairman made some general observations on the proformae. Each proforma should have a number which indicates the broad type of craft eg. '1' for non-mechanised boats, '2' for small mechanised boats, '3' for large mechanised vessels and '4' for culture fisheries. The numbers should have suffixes (wherever applicable) to indicate the type of operation eg. 'A' for trawl 'B' for purse seine 'C' for long lines etc.

Each proforma should clearly indicate the frequency of reporting eg. daily, each voyage or each operation. Items which CMFRI has to fill in (eg. code number) should be clearly specified perhaps by printing in different ink. Meterological and oceanographic data required in the forms (wherever applicable) should be of standard pattern. Eg. State of Sky-Blue/cloudy/............. etc. and Nature of Bottom-Muddy/Sandy .... etc. The directions for filling the proformae should be given at the end of the proformae pad.

The Chairman who was also the group leader for standardising proformae for large mechanised vessels viz. trawlers, purse seiners and long liners presented the report.

First the Chairman took up the proformae on trawlers (Form 3 A) and made the following suggestions. Fishing area should relate to the position at the

time of shooting of net. The direction of trawling should be in three digits. As for example N.E.405 and S.W.225. In the place of spread at mouth, length of head rope may be recorded. The columns 'Time of shooting from - to' and 'Time of hauling from-to' may be replaced by 'Time of completion of shooting' and 'Time of starting hauling'. A column mentioning length of warp may be inserted above that of 'bottom depth'. A new column to denote atmospheric pressure may be added. Under composition of catch, names of fishes may be omitted and instead blank columns may be provided to fill in species of prawns, cuttle fish, squids and fishes.

Shri R.Srinivasan, Joint Director, Department of Fisheries, Government of Tamil Nadu presenting the report of the Working Group on proformae for non-mechanised crafts.

Initiating the discussion Dr.Rama Sastry pointed out that the size of the log sheets should not be unwieldy to which Commodore Nair replied that data are recorded first in rough sheets and subsequently transferred to proformae. Lt.A.J.Lucose suggested that tidal corrections should be made at the time of recording bottom depth. For this Commodore Nair mentioned that when sophisticated instruments are available, this work may be undertaken. Shri P.Sulochanan suggested the desirability of recording the length of the horizontal and vertical opening of the head rope. Shri S.K.Dharma Raja stated that it would be helpful if automatic copying log sheets are provided. Commodore Nair mentioned that proformae for summary details may be deleted. However, fuel consumption for each voyage may be given. Regarding the proformae on long liners (Form 3C), the chairman stated that the committee suggested that the hydrographical and meterological data may be given both at the commencement of shooting and the end of hauling. Under depth range, the minimum and maximum depths of hooks may be recorded.

On the proformae for purse-seiners (Form 3 B) a few changes were suggested. The mesh size may be given at the top. Scouting time may be changed to scouting period. Regarding size of net, both length and depth may be recorded separately. The Chairman stated that the suggestions made on the proformae for trawlers which are relevant to purse-seiners and long liners may also be taken into consideration while finalising these proformae.

The Chairman then requested Shri. R.Srinivasan to present the report of the Working Group on non-mechanised boats. Shri Srinivasan stated that the proformae was unanimously accepted by the Working Group except for some minor changes. Instead of boat, the word craft may be substituted. (Form 1).

Dr.S.V.Bapat presented the report of the Working Group to standardise proformae for small mechanised boats (Form 2). Two major changes were suggested viz. i) introduction of a number of columns in the body of the proformae for collection of data on state of sky, state of sea, wind and current direction so that from each sampled boat the information on the same could be collected and (ii) introduction of a column for fuel consumption to be collected from each sampled boat.

During the discussion it was generally felt that while information on state of sky, direction of current etc., for each boat and, strictly speaking, for each haul is useful, practical difficulties in getting such data from small mechanised boat operators are too many and the dependability doubtful. As such it was agreed that the general features as in the proformae for non-mechanised boats only need be kept. If feasible separate data forms with all the additional details may be supplied to selected skippers to collect such information on an experimental basis.

Shri P.Sulochanan, Deputy Director, EFP participating in the discussions.

Regarding fuel consumption, it was agreed that since skippers in general would find it difficult to provide this information on daily trips and would be reluctant to part with any such data, the item may be dropped. However, considering the importance of stu-

dying the economics of fishing operations which include fuel consumption, it was felt desirable to take up case studies on selected boats from which the relevant data could be collected over a period by specially trained investigators. In the case of purse - seiners, the group suggested separate proformae for carrier boats and mother boats which land catches (Form 2 A-H). These suggestions were accepted.

The Chairman then stated that taking into consideration the requirements for transferring the data to cards/tapes/disks CMFRI may recast the format keeping in view the agreed decisions.

SESSION VI

PROCESSING AND DISSEMINATION OF DATA ON MARINE LIVING RESOURCES OF INDIAN SEAS

Chairman: Shri C.Vijay Ranchan I.A.S., Commissioner of Fisheries, Gujarat.

Rapporteurs: 1. Shri K.Krishna Rao, Scientist S-2, CIFT, Cochin. 2. Shri M.Srinath, Scientist S-1, CMFRI, Cochin.

The Chairman in his opening remarks stressed the importance of catch and effort data in fishery research and development and laid emphasis on collection of data relating to economic aspects of fishing operations. He pointed out the necessity for quick dissemination of information on biological aspects such as variations in stocks, spawning behaviour etc. to those who are actually engaged in fishing. He then requested Shri G. Venkataraman to present the lead paper

PROCESSING AND DISSEMINATION OF DATA ON MARINE LIVING RESOURCES OF INDIAN SEAS BY CMFRI*

Introduction

Estimates of marine fish catch landed and the effort expended as well as the data on biological aspects are essential prerequisites for the assessment of fish stocks along the Indian coast. With this objective in view, CMFRI has been collecting data on catch, effort and biological aspects over the past three decades. The processed data are published and made available to the Central and State Governments, fishing industry and various national and international agencies. Besides CMFRI, some of the state governments also collect marine fish catch statistics in their respective state. A brief review on the acquisition and dissemination of data by CMFRI on marine living resources of the Indian seas is given.

Acquisition

1. Data from Indigenous Boats and Small Mechanised Vessels.

About 100 field staff stationed at 42 centres, spread over in the 8 maritime states and 2 union territories, have been collecting catch, effort and biological data from about 1400 landing centres based on multistage stratified sampling design. Work programme for each month are sent to them from headquarters sufficiently in advance. Each field assistant makes observations for 18 days in a month. He collects data on the total number of boats landed and on species-wise and gear-wise catch and effort expanded from a sample of boats. He also collects biological data from subsamples of commercially important species. Recently the field staff have been instructed to collect data on the prices of different varieties of fish. He records the field data in the prescribed proformae for both the indigenous and mechanised crafts.

The field staff send the data in the prescribed proformae for the particular month during the first week

*Prepared by G.Venkataraman, K.N.Kurup and M.Srinath, Scientists, FRA Division, CMFRI, Cochin and presented by G.Venkataraman.

of the succeeding month. The data received at the Headquarters of CMFRI are scrutinised and processed at the computing laboratory in the Fisheries Resources Assessment Division of the Institute. Estimates of species-wise marine fish landings and also fishing effort in terms of number of operation of different gears and the fishing hours in the various maritime states are obtained.

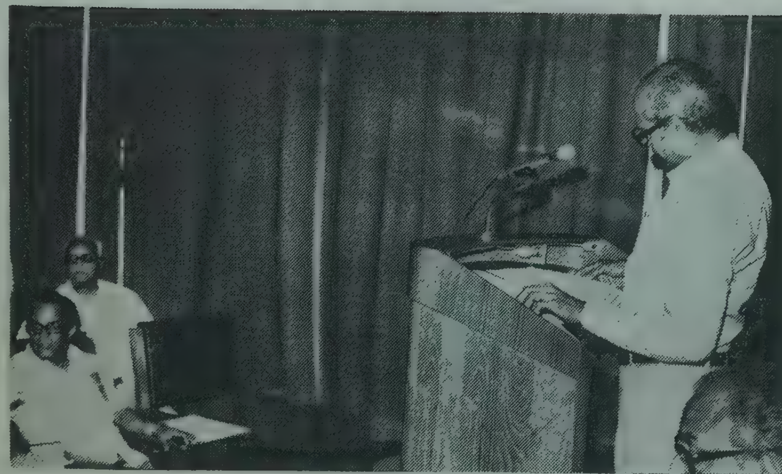
Before publishing the processed data, discussions are held with those state governments who collect marine fish catch statistics. During the discussions, the estimates arrived at by CMFRI and those by the states concerned are compared and pooled estimates are made as and where there are some differences.

Chairman: Shri Vijay Ranchan, I.A.S., Commissioner of Fisheries, Government of Gujarat.

The work of the field staff at the landing centres is supervised periodically by the field officers and the scientists stationed at the different research and field centres so as to ensure proper identification of species and collection of data. Refresher courses are organised at Headquarters and different research centres to keep the field staff abreast of the latest developments in the identification of the different species. Workshops are organised once a year to review the previous year's work and to discuss matters concerning collection of data and ways and means of improving the same. Updating of landing centres, review of any change in the fishing pattern and also special features like fuel shortage or natural calamities are taken note of for necessary action.

2. Offshore Data

Data on catch of fishes obtained from the vessels operated by the EFP and IFP are received at the Headquarters of CMFRI and they are analysed in terms of species-wise depth-wise and area-wise occurrence. Data from very few larger private trawlers operated by Indian companies and also from some vessels working on a charter basis are received and processed.


Dr.S.S.Pillai Joint Director IASRI presenting the invited paper on information system.

3. Census Data

Information in respect of the number of fishing villages, landing centres, fishermen population, fishing crafts and gears and infrastructure facilities available is essential for planning of development programmes in the marine fisheries sector. Updating the list of marine fish landing centres is required for the estimation of marine fish catch. With this objective in view, CMFRI has been conducting marine fishermen census periodically from 1947 onwards. In 1980, a fresh census was conducted within a short period of less than a month on an intensive and massive scale availing the services of 1500 persons employed locally under the direct supervision of 165 scientific and technical personnel of the Institute. About 2000 marine fishing villages were visited covering nearly 3 lakh househoods and information on the fishermen population and the available infrastructure facilities was collected in specially designed comprehensive proformae. In this venture the Institute received active support from all the State Fisheries Departments.

4. Biological and Environmental Data

During the last three decades the scientific and technical personnel of the Institute have been collecting data in suitable proformae on morphometric and meristic characters of commercially important fin and shell fishes besides on food, migration patterns, sex ratio and stages of maturity.

Environmental data relating to physical oceanographic aspects such as currents, tides, wind direction and upwelling as also on chemical oceanographic parameters such as salinity, oxygen content, phosphates, nitrates and silicates are being obtained.

There is immense scope to augment fish production by mariculture in our country which has vast areas of lagoons, backwaters and bays suitable for this purpose. In the field laboratories and demonstration

farms, the scientists of the Institute have been making studies on the stocking density, rate of growth, food and feeding and induced breeding and the data on the same have been recorded.

Dissemination

After processing the data, the estimates of species wise total marine fish landings of the different maritime states and union territories are published in the *Marine Fisheries Information Service* (MFIS) as well as in the annual reports and special bulletins published by the Institute. From the year 1981 onwards, estimates of landings along with the effort (unit operations) by mechanised and non - mechanised sectors are also being given separately. Estimates of fish catch landed at some of the major fisheries harbours in the country have also been furnished.

Some changes have been effected in the species - wise presentation of catch data from 1981. The existing 27 groups of fishes have been revised with a view to bring in the related genera and species of fishes under the relevant headings. Under some groups further categorisation is done on the basis of their commercial importance. For instance,the pomfrets have been categorised into black, silver and chinese pomfrets. Based on the data on catch, effort and biological aspects collected by the Institute, stock assessment of some of the commercially important fishes have been made and the results published in MFIS, *Indian journal of Fisheries* and special publications. Addtional information relating to marine fish catch is also furnished to the extent possible to the various agencies both Governmental and non - Governmental bodies on request.

The processed census data collected in 1980 were published in MFIS No.30 (August 1981) giving district - wise details on the distribution of marine fishermen population, their educational status, number of fishermen actually engaged in fishing and various types of crafts and gears.

The Institute has been carrying out case studies pertaining to socio-economics and also on impact of mechanisation. Special investigations to assess the losses caused by calamities such as cyclone and fire of great magnitude have also been undertaken and published.

Future Plan

The existing strength of field staff engaged in the collection of data will be doubled during the Sixth Plan period increasing the coverage from the present 2.0% to 3.5%. With the greater coverage, it would be possible to furnish district-wise, quarter-wise and important gear-wise estimates with greater precision. It would also be possible to give estimates of fish catch landings for all the important fisheries harbours in the country.

With the declaration of Exclusive Economic Zone the area of fishing has increased manyfold from 0.1 million sq. km. to 2 million sq.km. Surveys carried out by the vessels of EFP., IFP., and the erstwhile PFP showed that there exists in abundance in our coastal waters a diversity of species such as oil sardine, mackerel, other sardines, whitebaits *(stolephorus spp)*, ribbonfishes, catfishes, silverbellies, horse mackerel and scads whose landings are being augmented by newer methods of fishing like purse seining. These surveys have also revealed the existence of vast non-conventional fishery resources beyond 50 m. depth in the continental shelf and upper continental slope. This has led to the possibility of increased landings, among others, of deep-sea fishes, squids, lobsters and prawns. The landings of oceanic species such as tunas and bill fishes are expected to increase considerably with the operation of our vessels in the high seas.

Consequently, quantum of data received at the Data Centre of CMFRI will considerably increase in the coming years. For quick processing of the voluminous data and the rapid dissemination of the information, it is essential to develop a computerised system at this centre. It has been rightly pointed out by the Planning Commission that the National Fishery Data Centre should be developed at CMFRI with a computerised system. Such a system will facilitate bringing information in a detailed manner and carrying out in-depth sutdies for developing suitable fishery management policies.

With this objective in view, advance action for the computerisation ot the data has been taken. The common marine living resources of the Indian Seas have been classified under different groups such as fin and shell fishes, marine turtles, marine mammals, sponges and seaweeds and code numbers have been given to the genera and species falling under these groups. Altogether 922 species have been listed, of which 671 species come under fin fishes and 112 species under shell fishes. Codes have also been given to the various maritime states, districts, zones, landing centres and types of fishing crafts and gears. The existing proformae have been recast to accommodate codes and the process of filling the coded data has been initiated.

This Institute, with the expanded programme of acquisition and idssemination of data on living resources of Indian seas, will be of greater service to the end users in the coming years.

Discussion

Commodore Nair expressed the need for delineation of fishing zones exploited by artisanal fisheries, small machanised boats and large vessels. Shri.G.Venkataraman replied that dilineation would be possible once detailed depth-wise analysis is made and the acquisition of computer would facilitate this task. The Chairman said that there is a need for proper utilisation and coordination of available manpower for collection of catch statistics. At present catch data are collected by both CMFRI and the respective state agencies. He felt it would be better if the states were asked to collect catch data and CMFRI concentrates on case studies and certain specialised studies. Shri.T-.Jacob and G.Venkataraman were both of opinion that the catch and effort data at micro level are essential to link up the biological observation for assessment of stocks. Dr.K.Alagaraja remarked that in a large scale survey of population exhibiting wide variations it is advisable that more than one agency is involved in collection of statistics. He also emphasised the need for following uniform sampling design for data collection by all the agencies concerned and added that CMFRI would certainly be able to help in formulating such a design.

The Chairman then invited Dr.S.S.Pillai, Joint Director, IASRI, New Delhi to present his paper.

PROBLEMS AND PROSPECTS IN ESTABLISHING MARINE FISHERIES INFORMATION SYSTEM*

1. What is Data Processing?

Statistical data collected through surveys, censuses, experimental observations or from official records are usually very voluminous. They have to be processed, classified, condensed and summarized into few statistics in order that the information contained in them may be comprehended. The systematic execution of these operations on the data to achieve this is known as 'data processing'. The basic data collected in source documents are the primary 'input' to the data processing system. These data are subjected to various operations like scrutiny, conversion into machine readable form, if machanical processing is done, editing, cleaning, sorting, merging and tabulation to produce 'output'. The nature of processing will depend on the volume of input data and on the equipments and methods used. The number of processing functions will be many, whatever be the method adopted. The final outputs are generally tables, results of statistical analysis, functional relationships, estimated values and projections based on hypotheses. There can however, be intermediate outputs which are stored for further processing at a subsequent stage. Processed data is referred to as "information" because the result of processing is often used for making policy decisions.

2. Steps in data processing

The work of data processing starts when proposals for collection of data are formulated. The method of processing envisaged, the type of personnel available to do the work, methods to be adopted for analysing the data, and method of distribution of the output to the users will have to be considered at this stage itself. The design of theproformaesin which basic data are to be collected depends upon the processing methods and equipments used. By suitable designing of the forms considerable savings in processing time, economy and increase in efficiency can be achieved.

3. Coding

If data collected from the field are entered in the forms in terms of numeric (or alphanumeric) codes, processing of such data will become more easy then when description in words are entered . Description in words has drawbacks like:

(i) For entering data into cards or other storage media more space will be required.

(ii) Variation in spelling will lead to multiple classification of the same item.

(iii) Processing will be more time consuming than when coding methods are adopted

3.1. Coding Principles

The preparation of codes is done keeping in view the way in which data will be processed and the type of machines on which processing will be done. Codes are better prepared by group of subject matter specialists when the classification is extensive. Given in Appendix is a list of codes used by Food and Agriculture Organisation to classify documents relating to

*Prepared and presented by Dr.S.S.Pillai, IASRI, New Delhi.

aquatic animals in the creation of their information system for agricultural Sciences and Technology. Codes of this kind are so designed that they can be expanded to add more classifications. It will also be possible to make breakdowns into sub - classes when required. A good coding system should produce codes which are simple, as short as poossible and convenient to use. When the number of codes is very large the field workers are supplied with printed list of codes, preferably in coloured pages, different colours being used for specifying codes for the different items.

3.2. Self-Coded schedules

It is always easy, both in manual and automatic data processing, to analyse data if entries in source documents are classified with preassigned codes. For instance in a sample survey meant for estimating the animal life in the sea the processing of the data will be more easy if the forms used in the field are designed as in the table given below:

Number of animals caught

Type	Code	Number
Fish	1	
Crustaceans	2	
Molluscs	3	
Reptiles	4	
Other aquatic invertebrates	5	
Other aquatic vertabrates	6	
Any other aquatic animals	7	

The field workers are only required to enter the count of each of the species against the required classification.

This will reduce errors at various stages of tabulation and facilitate quicker summarisation of data. In many cases classification of qualitative and quantitative characteristics can be incorporated in the proforma at the design stage in this manner. The classification has however to be done very carefully and the person collecting the data should not have any difficulty in choosing only one of the alternatives provided under each item of enquiry.

The proforma used for collecting data should be got printed in such a manner that while transferring the data into punch cards or other data storage devices, all the data required to be stored in a record is available in a page of the proforma.

Preparation of data for mechanised tabulation takes considerable time, and lot of errors can occur in data transference. The proper organisation of recording of information helps in reducing the errors and speeding up the operations.

4. Editing of Data

Data collected through enquiries, or from documents are likely to have errors at various places. These errors occur due to incomplete and wrong response to enquiries wrong record of information by the field worker, lack of knowledge on the part of the respondent, etc. The errors in the document should be corrected by 'editing' it before the tabultions and analysis is taken up. When computers are used for tabulation of data, the editing work can be done with the help of suitable computer programmes. Editing is based upon comparisons of the values for their range and consistencies between different fields. For correcting errors reference to the field for cases where discrepanies cannot be solved logically will be required.

5. Preparation of tables.

Once the data are corrected of all errors, tabulation can start. Tabulation will consist of sorting the data according to desired classifications, and totalling of quantitative information in the classes. Totals and counts are often made for meaningful sub populations and pooled over to get the global tables.

6. Methods of processing data using manual methods

When the data to be processed is relatively small and the computations required to be done on the data elements are few and simple, manual methods are more economical and faster than mechanical procedures. In manual tabulation sorting is done by handling of individual records, and the classified documents are counted. The quantitative information in various classes are totalled mentally or by using simple calculating machines to make the tables.

7. Mechanical Tabulation methods.

In order to use machines for data processing the information collected will have to be transferred to machine readable recordes. A variety of machines are used for processing, like key punches, mark sense readers, optical character readers, magnetic ink character readers, sorters, collators, tabulators and elctronic computers for doing the processing. A description of the various mechanical aids used as follows.

7.1. Punch-card Machines.

The obstacles in machine processing of documents are (i) the original documents are generally of varying size, shape and thickness; (ii) one source document like a filled up proforma contains a large

number of entries and tabulation of some or all of these entries will be required; and (iii) the entries made by field workers and clerks in the documents are in varying styles of handwriting and inks. A machine which can cope-up with mechanical processing of data contained in media of such complexity cannot be made. The solution which was found for this is to have standard cards of uniform size and thickness and to have a predetermined and unique pattern for encoding data on them. The most common medium for entering data is the 80 column punch-card. Holes punches in cards using punching machines, in a standardised pattern are used instead of the normal methods of recording data. The process of recording data is known as key punching. The data entered in the cards will have to be verified to ensure that mistakes have not entered. This is known as verifying.

There are some variations in the mode of recording data on punch cards based on the pattern of holes made for representing different characters. The most commonly used of the methods are punching Binary Coded Decimal (BCD) and Extended Binary Coded Decimal Interchange Code (EBCDIC) formats. In both cases digits, alphabets and other characters normally used in science and business are represented by one, two or three holes in the concerned columns.

7.2. Processing punch cards

Separate machines are used for punching data into cards and for verifying the punched cards. Two machines and two operators are thus required in comparison to only one direct entry or key-to-magnetic medium machine needed for converting source data into machine readable form. For processing punched cards, sorters, collators, reproducing punches and tabulators continue to be used in many offices in India.

8. Key-to-tape-devices

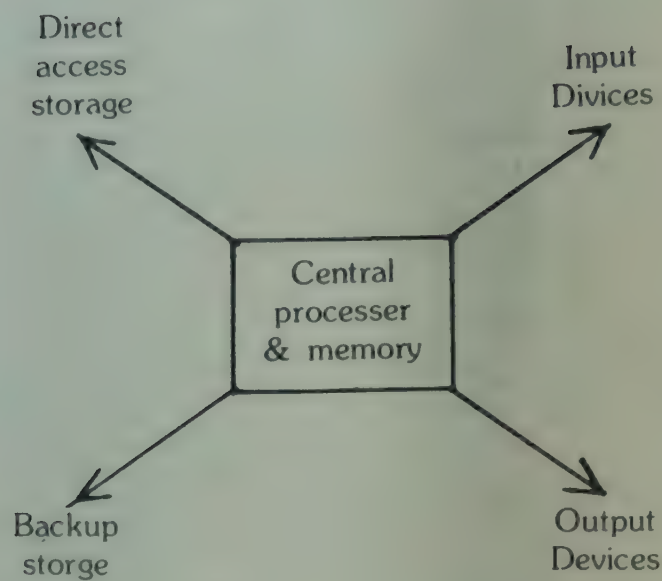
The punched card machines described above have been in use for more than three decades in data processing. When cards are used as input medium for computers it was observed that the transfer rate was quite low due to limitation of reading speeds, and mechanical problems like read-checks, jamming of cards, etc. A solution that worked well was to transcribe data on to magnetic tapes by using off line devices, and then read the tapes. Though this method was satisfactory the basic problems associated with the cards remained, viz.; (i) cards once punched cannot be reused (ii) cards are costly (iii) cards require lot of space for storage (iv) strict control over environment was necessary to ensure good operating condition. Key-to-tape, Key-to-disk, Key-to- diskette and key-to-cassette devices came into vogue which eliminated most of these drawbacks.

In key-to-tape device the data keyed on the keyboard similar to the keyboard of punching machine is held in a buffer. When a record is completed the operator can display the contents of the buffer and make corrections. While typing data the operator can back-space to correct an error committed by wrong depression of a key. Once the contents of the buffer are checked for correctness, the entire record is written on the tape. In key-to-cassette and key-to- diskette devices the technique used is the same except that the recording takes place on casette or floppy disks to be transferred later on to standard magnetic tapes. In some installations the data preparation devices are connected directly to a computer which, in multi-programmed environment, will co-ordinate data entry from multiple key-to-disk stations. Due to low cost of data preparation per character recorded, reusability of the recording medium, greater flexibility in record size, reduction in requirements of storage space and greater productivity key-to-disk, key-diskette and key-to- tape devices will gradually replace punch card devices.

9. Electronic computers

9.1 Unlike unit record machines mentioned in previous paragraphs, the electronic computer is a versatile general purpose machine capable of processing large amount data at very high speeds. The computer is self controlled and operates by executing instructions stored in its main storage (memory). A modern computer is characterised by its ability to access very large amount of data stored in auxiliary storage devices. Such devices may be located either in the centre where the computer is installed or elswhere. Computers can also communicate with each other when they are connected in a network.

9.2 A computer has basically the functional units given in figure.1. The capability of the computer depends on the number and capacity of each of these functional units. The choice of a computer and peripherals for an organisation depends upon the type of data processing it has to do. For statistical work in which data collected from censuses and surveys are to be tabulated, large direct access storage is required for efficiently sorting data in order to prepare different kinds of reports. Back up storage devices will be required to record and preserve the original data and / or tabulated results for future use. The commonly used direct access storage device in microprocessor based computers in the floppy disk and the winchester disk. In big systems large capacity removable diskpacks are used for direct access storage. Magnetic tapes are used for long term storage of data.



9.3. Software

Modern computer systems operate under the control of a master programme known as the Operating System (OS). The Operating System looks after management of the resources available in the computer system. Besides the O.S, there are programming language compilers for compiling and executing user written programmes in languages like FORTRAN, COBOL, PASCAL, PL/I, BASIC and ALGOL. Statistical work can be easily and efficiently programmed on computers which have FORTRAN, BASIC, PL/I or ALGOL compilers. Languages like COBOL and PL/I are suited to process data in which much of computation are not involved, but most of the work is manipulation of data files and text-material to produce reports. A number of utility programmes are also usually included in the software supplied by manufactures of computers.

9.4. Information systems

Most of the work done by scientists, administrators and office workers result in production of enormous amount of textual information. This paper work explosion is an ever increasing phenominon in our society. Modern office equipment industry has provided word processors, copiers, printing and dictation equipment which contribute to multiplication of paper work at a faster rate. It is estimated that more than 60% of the time of office staff and scientists is spent on merely searching for information scattered in different files or documents. Even when relevant papers are located, considerable amount of collation and summarisation of data is required to produce the desired information.

9.5. Computer based information systems are designed to store data in suitable data structures so that retrieval of desired information is easy. The stored data in the computer system is known as "DATA BASE". In order to establish a data base, the computer system should have large Direct Access Storage Devices, besides the software (generally known as Data Base Management System Software) for creating the data base and for compiling programmes written in the "host language" for retrievalof information. Many microprocessor based computers provide data base software. Due to limited direct access storage available on these systems, these can be used only for developing information systems of relatively small size.

Computer based information systems are created in applications where constant changes take place in the attribute values of the entities in the system, a very frequent analytical summaries are required by a number of persons. Such systems are implemented in manufacturing and distributing concerns, universities, groups of libraries etc. Data base management systems used in such business environment are known more generally as Management Information Systems (MIS). MIS helps in taking decisions on various actions like type and quantity of goods to be manufactured advertising strategies to be adopted, price fixation and clearance of accumulated goods, DBMS implemented,

in Universities, help in managing different courses, class rooms, allocation of work to faculty members, following progress of students, preparation of transcripts and so on.

9.6 For creation of an information system the first step is to do an extensive analysis of the physical system and design procedures for collection of data on the attributes of all the entities in it. The collected data are defined and stored in the computer system using DBMS software. The file structures used depend upon the relationships between entities in the physical world. The responsibility for deciding what data to be stored in the system and the way in which data are stored vests with the Data Base Administrator. Thereafter application programmers prepare retrieval programmes to be used by the users of the data base. The advantages of storing data in a Data Base are:

(i) Datum relating to a specie attribute is stored only in one place in the system. This ensures that consistent reports are generated, even after any number of updates.

(ii) The way in which data are stored in the devices is not of any importance to the programmer who desires to develop retrieval programmes.

(iii) The structure of the data base can be changed by the Data Base Administrator without affecting the existing application programmes.

A mechanism has to be built into the data base set up so that changes taking place in the real world are incorporated in the data base as and when the changes occur. Unless this is done meticulously the information system developed on the data base will not be of any use.

10. Computerised fisheries information system

It is the context of what was discussed about the present day information systems that we examine the prospect of implementing a fisheries information system. A complete inventory of the living resources of the sea can never be done. Data can be collected only through sample surveys. Similar is the case with the resources that are exploited. When sample surveys are conducted, the data collected can be analysed extensively and all meaningful tables made and presented in printed reports. Changes taking place in the resources cannot be ascertained easily. Moreover, it is not likely that a number of users will like to use the data for analytical purposes very frequently.

10.1 The use of computers in processing and dissemination of data on living resources of the sea will therefore, consist of analysis of voluminous data collected through censuses, surveys, meteorological workers, scientists and technical staff. The surveys may be on fish catch, boats and gears used, fishing population & their living standards, marketing and economic data etc. A fast computer system which can process extensive data with large direct access storage, adequate memory for statistical data processing and magnetic tape units (for storage of data over long periods) is required for this. Adequate software for statistical data processing should be available on the computer so that detailed analysis could be done effortlessly.

11. Existing information systems.

There are a few information systems, which deal with fisheries, implemented by international organisations. The international Information System for Agricultural Science and technology (AGRIS) sponsored by the Food and Agriculture Organisation of the United Nations (Rome) is a bibliographic data base with international coverage. All aspects of agriculture including Forestry, Veterinery Sciences, Fisheries and Human Nutrition are covered in this. The system provides references to documents (books, articles, films, standards, patents, conference papers .... .) on the topic mentioned above. Magnetic tapes containing entries in the data base from 1975 onwards are available from AGRIS co-ordinating centre of the FAO. Another information system of interest particularly to workers in Fisheries is the Aquatic Sciences and Fisheries Information System (ASFIS) implemented by the United Nations (New York), FAO of UN (Rome) and the Inter Governmental Oceanic Commission (Paris). Magnetic tapes containing this data base are also available from F.A.O. This is also a bibliographic information system containing abstracts of documents in biological and living resources, ocean technology and policy as well as non-living resources. The system monitors abstracts of about 15000 documents each year. Two other data bases of interest are the World Catch Data Base (FSHDB) and Marine Environmental Data Referral System (MEDI) both of which are developed by UNESCO. Any computer system aquired for processing fisheries data must be capable of using these data bases.

Acknowledgement

The author is indebted to Dr.Prem Narain, Director Indian Agricultural Statistics Research Institute for permitting to present this paper in the "National Workshop on Acquisition and Dissemination of data on marine living resources of Indian Seas".

APPENDIX

Codes used in AGRIS for commodities connected with Aquatic Sciences and Fisheries

8000	Aquatic Animals-general
8100	Fish-General
*8105	Freshwater fishes-Gen.
8100	Carp
8120	Eels
*8126	Perchs
8130	Salmon and trout
*8134	Tilapia
*8145	Brackish-water fishes
*8150	Marine fishes-general
*8151	Anchovies
*8154	Haddock
*8161	Herrings
*8166	Mullet
*8172	Sardines
*8174	Soles-flatfishes
*8182	Turbot
*8195	Marine fishes-other
8200	Shellfish-general
8300	Crustaceans-general
8310	Shrimps and prawns
8330	Lobsters and crayfish
8400	Molluscs-general
8410	Clam
8420	Mussels
8440	Oysters
8499	Shellfish-other
8500	Reptiles and batrachians-general
8510	Crocodiles and alligators
*8525	Salamanders
8530	Turtles
8600	Various aquatic invertabrates-general
8610	Bryozoa
8630	Echinoderms
8650	Sponges
8700	Various aquatic vertebrates-general
*8710	Whales, porpoises, dolphins
8720	Seals, sealings, walruses
8790	Aquatic animals-other
8800	Various animals utilized by man-general
8810	Game animals
8860	Pet animals
* ---	Dogs, use 5400
* ---	Cats, use 5500
8890	Various animals utilized by man-other
*8891	Other animals (i e.species categorized in POO)
*8115	Catfish
*8124	Milkfish
*8128	Pike
*8133	Sturgeon
8140	Freshwater fishes-other
*8153	Codfish
*8160	Halibut
*8165	Mackerel
*8170	Plaice, flounders
*8173	Sharks
*8180	Tuna
*8190	Whitings
8320	Crabs
8390	Crustaceans-Other
*8415	Gastropods (Snail-like-molluscs)
8430	Octopus and squid
8490	Molluscs-other
*8520	Frogs, toads
*8527	Snakes
8590	Reptiles and batrachians-other
8620	Coelenterates
8640	Marine worms;
8690	Various aquatic invertebrates-other
*8715	Dugongs, manatees
*8750	Various aquatic vertebrates-other
8830	Laboratory animals (except insects and mites reared for biological control use 7300)
*	Rabbits, use 5600

After the presentation of the paper, the Chairman elicited discussions from the delegates. In answer to the enquiry by Commodore Nair about the type of information system which could be adopted by CMFRI, Dr.Pillai Suggested that CMFRI should initially go in for a medium type fast computer which can grow as per requirement. As the data input increases in volume, necessary modifications could be made to the computer for developing a proper information system.

SESSION VII

Plenary Session

Chairman: Dr. E.G.Silas, Director,
CMFRI, Cochin.

Rapporteurs: 1. Shri R.Srinivasan, Joint Director, Department of Fisheries, Tamil Nadu

2. Shri G.Venkataraman, Scientist S-3, CMFRI, Cochin.

The Chairman stated that based on the discussions in the earlier sessions the recommendations were drafted by a Committee comprising of Dr. E.G.Silas, Shri. V.Ramamurthy, Commodore K.M.V.Nair, Dr. P.V.Rao and Shri T.Jacob and placed the draft recommendaions before the house for discussion and adoption.

DISSCUSSION ON DRAFT RECOMMENDATIONS

Constitution of an advisory committee (Ref. Rec.1.2)

Shri.C.Vijaya Ranchan said that what was needed was not an advisory committee with large number of members meeting frequently but a smaller expert committee to see the system working.

Shri.B.B.Lal stated that there is need to integrate the different methods of data collection by the States and CMFRI should see to the enforcement of the system.

Shri.K.Krishna Rao suggested the need for a coordination committee which would be constituted in this workshop itself. Commodore Nair stated that to get over the teething trouble, constitution of committee represented by CMFRI and States was thought of.

The Chairman agreeing with the above suggestion said that an expert committee could be constituted which would meet periodically to review the problems connected with collection of catch data, with CMFRI as the coordinating body. The term of the committee could be for a period of two years.

Organising of National Marine Living Resources Data Centre at CMFRI (Ref. Rec. 1.1).

Shri.Vijay Ranchan said that the recommendation may cover dissemination of other related data also.

Strengthening of data collection units in States (Ref. Rec. 2.).

Shri.M.K.Sankaran Kutty suggested that in the place of State Fisheries unit, State departments collecting fishery statistics may be incorporated in order to cover concerned agencies.

Shri.Mhaiskar suggested that the structure of the statistical cell may be defined.

Shri.Vijay Ranchan said that the word 'desired coverage' is vague and an expected coverage may be specified, for which Dr.Silas stated it could be 5%. In regard to provision of funds for 5% coverage, Shri. B.B.Lal mentioned that the States need not depend on the centre for the same. The Chairman stated that the states should strengthen their staff for a coverage of 5% to begin with and the centre, as recommended by National Commission on Agriculture, may render some financial assistance towards achieving the above objective.

Data collection pertaining to small scale fisheries by States (Ref. Rec. 3.1)

Shri.J.D.Mhaiskar said that Maharashtra Government are collecting data based on their own design which is slightly different from that of CMFRI. Shri-Vijay Ranchan said that states can follow the designs formulated by them with the provision that they should be collected in the proformae standardised by CMFRI. In this connection Shri. T.Jacob pointed out the advantages of having a common design particularly for arriving at comparable estimates.

Data Collection pertaining to small scale fisheries by CMFRI (Ref. Rec. 3.2)

The recommendation was approved without any change.

Catch statistics (Ref. Rec. 3.3)

Regarding the acceptance of estimates brought out by the National Marine Living Resources Data Centre by all agencies, Shri.Lal said that the estimates arrived at by CMFRI should be reconciled with those obtained by the States and common estimates should be arrived at and furnished to the Ministry. He also added that now the Ministry is insisting the State Governments to send reconciled figures.

Dr.Silas said that there is time lag in publishing the annual catch figures as they have to be reconciled with that obtained by the states. The process of reconciliation has to be speeded up so that the annual catch estimates can be published without delay and in this he sought the cooperation of the states.

Shri V.Ramalingam, Joint Director MPEDA participating in the discussions.

Data acquisition of other fishing operations including the larger fishing vessels (Ref. Rec. 4.1)

Shri.Vijay Ranchan observed that it should not be made obligatory on the parties engaged in offshore fishing to give the data to CMFRI as compulsion may not yield desired resutls. Commodore Nair stated the mandatory clause was introduced as the response was generally very poor from the owners of the chartered vessels. Shri R.Sathiarajan stated that the owners of the chartered vessels should be impressed upon that the data obtained by CMFRI will be used for resource assessment studies only and not for any other purpose. Shri. K.H.Mohamed suggested that the confidentiality of the data supplied by the companies should be maintained. Dr.P.Vedavyasa Rao felt that the supply of data by larger trawlers operating in off- shore waters should be made obligatory as at present we have no reliable estimate of fish caught by them. Shri.M.Swaminath stated that in the case of chartered vessels the Ministry has made it obligatory for them to furnish the fish catch data obtianed by them. He further observed that the furnishing of data by vessels other than the chartered ones need not be made obligatory. Dr.Alagaraja suggested that it should be obligatory for not only chartered vessels but also for all the vessels to supply the data. Commodore Nair stated that participation of the scientists in cruises of the chartered vessels will be useful. Dr.Rama Sastry suggested that data from all the large vessels should be sent to CMFRI and the Ministry should take appropriate measures to ensure the same.

Shri J.D.Mhaiskar, Statistical Officer, Department of Fisheries, Government of Mahrashtra participating in the discussions.

The Chairman said that two differing views were expressed by the delegates, one supporting the view that the supply of data should be made obligatory on the part of chartered vessels, the other view being that it need be made voluntary. The Chairman observed that some amount of persuation and goodwill is necessary to obtain the data from the companies operating large trawlers.

Modus operandi of data supply (Ref. Rec. 4.2).

The recommendation was accepted.

Data processing and storing (Ref. Rec. 5.1)

Dr.S.S.Pillai suggested that CMFRI, in addition to processing of data received through their own staff, may also undertake processing of data received from the States. Shri.Jacob, stated that at present the Institute has a large quantum of data for processing for which a computer is essential.

Dissemination of data (Ref. Rec. 6)

Dr.Silas stated that consultancy service is given by CMFRI and this service would be strengthened in the coming years. In this connection Shri.M.Swaminath suggested that inclusion of the findings of other National Fishery Institutes may be considered wherever necessary.

Shri.V.Ramalingam wanted that a time limit should be fixed in the publication of yearly fish catch statistics. The Chairman explained that the delay is due to the need to reconcile the estimates obtained by

CMFRI with the figures obtained by concerned State Governments. He sought the cooperation of the State Governments in speeding up the reconciliation process so that the catch figures are published much faster.

Environmental and meteorological data (Ref. Rec. 7.1).

Dr.Rama Sastry stated that IMD can render free specialised information service meant for the benefit of fishermen and the various State Fisheries Departments on request. He also added that IMD will be in a position to provide some required meteorological instruments to the larger vessels for recording important parameters. The Chairman appreciated the gesture of the IMD.

Endangered species (Ref. Rec. 7.3)

Dr.Silas referring to data collection by CMFRI emphasised the importance of collecting data relating to the capture of endangered animals like whales, dugong and turtles in the Indian seas. Their resources are fast dwindling because of their indiscriminate slaughter and hence their capture is banned under the Wild Life Protection Act. In this context, the Chairman said collection of catch statistics on these animals will help the Government in monitoring their resources in our waters. He said that a suitable recommendation will be prepared in this connection.

In conclusion Dr.Silas stated that he was happy to note that the recommendations were by and large accepted and mentioned that whatever modifications required will be made in the recommendations, taking into consideration the suggestions made by the delegates. He further said that the modified recommendations will be sent to them in a week's time and comments if any might be communicated to CMFRI in about 15 days time so that further action could be taken.

In his concluding remarks, Dr.Silas said that this is the first time that an all India Workshop on acquisition and dissemination of data on marine living resources of Indian Seas was held and it has underlined the importance of national effort in this process and the necessity for the information to be made available to the Centre, States, fishing industry and enterpreneurs in the fisheries sector at the shortest possible time.

He further stated that the proceedings of the Workshop would be published shortly. He thanked the Chairmen of various sessions, Group Leaders and Rapporteurs of the various sessions for the hard work they had put in and also the delegates for their active participation in the workshop.

The session came to a close with vote of thanks proposed by Shri.G.Venkataraman.

RECOMMENDATIONS

The critical population/food dilemma facing the country has stimulated substantial interest in the sea as source of food and raw material. The central theme of this Workshop has been to enlarge and improve the system of acquisition, processing, analysis and storage of data, and retrieval and dissemination of information on marine living resources, both exploited and exploitable, in general and fishery resources in particular. Before one launches into exploitation and management of these resources, this Workshop has stressed the imperative need to recognise the basic requirements of resources data and to find out ways and means of organising the data system with a view to fostering greater understanding of the resource status, complex exploitation problems faced by the artisanal, mechanised and industrial sectors, and the socioeconomic structure. On the strength of such knowledge would one be able to call the attention of the policy-makers and administrators to ensure judicious exploitation, management and conversation of the resources. Having deliberated the pros and cons of data acquisition and the corollary aspects of dissemination in the light of the opportunities and challenges available in the context of new ocean regimes, the Workshop makes the following recommendations for effective implementation by the concerned agencies While making these recommendations the Workshop recognises the paramount benefits of an integrated centralised system of data acquisition and information dissemination with its complementaries to the end user in various spheres and to the nation.

1.POLICIES AND PRIORITIES

1.1. The Workshop

realising the vital importance of data on marine living resources in general and fishery resource in particular in the seas around India for planning development and management of this sector, and

considering the long coastline of the country including the Island territories, various types of crafts and gears employed in the exploitation, the nature of landings, the large number of landing places, and the socioeconomic aspects,

recommends that as directed by the Planning Commission, the Central Marine Fisheries Research Institute (CMFRI), the premier Institute in the country responsible for providing research and development support for the exploitation, management and conservation of these resources, should immediately strengthen and expand its Fishery Dat. Centre as a centralised National Marine Living Resources Data Centre (NMLRDC) and that, the NMLRDC be responsible for acquiring, processing, analysing and storing of data and disseminating the information on the marine living resources and related aspects.

Action to be taken by: Indian Council of Agricultural Research; CMFRI.

1.2. The Workshop,

observing the deep involvement of States, Department of Agriculture of Union Government Central Government organisations, Indian Council of Agricultural Research, public and private organisations in the development and exploitation of the marine living resources of the country

noting that resources information is the essential basic prerequisite for all the R & D programmes,

emphasising that there should be a coordinated and integrated approach to the entire system of data acquisition and dissemination of information and

feeling keenly the necessity of a body to coordinate the entire system in the country through the NMLRDC at the Central Marine Fisheries Research Institute,

recommends that an Expert Committee to guide the modalities of functioning and to foster linkages with various organisations in the initial stages may be constituted for a period of two years by the Union Department of Agriculture, and that the Expert Committee, to be set up immediately, be comprised members representing the States, Central Government organisations, ICAR, and public and private Sector organisations with the Director CMFRI as Convenor, and

further recommends that this Expert Committee meets periodically and discusses the progress and constraints in the field and provides guidelines and advice for an effective and functional system for resources data collection and dissemination of information

Action to be taken by: Department of Agriculture, Government of India; Indian Council of Agricultural Research; CMFRI.

2. STRENGTHENING OF DATA COLLECTION UNITS IN STATES

The Workshop,

noting that the States are primarily concerned with fisheries development within the territorial waters and that the major portion of the exploited fishery resources is produced at present by the small scale fisheries sector, the data on which are collected by the concerned Departments in the states,

recommends that the State Departments collecting marine fishery statistics be strengthened for this purpose with adequate administrative, technical and financial support so as to ensure a coverage of at least 5% of landing centre-days for data collection and their further analysis.

Action to be taken by: Departments of Fisheries / Statistical Bureaus, Governments of maritime States and Union Teritories.

3. DATA ON SMALL-SCALE FISHERIES (ARTISANAL AND SMALL MECHANISED FISHERIES)

3.1. Data collection by States

The Workshop,

observing the complex and diversified nature of fishing opertions, wide fluctuations in landings and constraints encountered in complete enumeration of data and

noting that the staff engaged in the resources data collection in the States require periodic training and orientation in the data collection and recording system and

further noting that reliability of the data basically depends on the system of collection,

recommends that a system of data collection based on tested statistical design developed by CMFRI be followed by all the States and that the data are recorded and maintained in the accepted proformae drawn up for the purpose in this Workshop; and

further recommends that the field staff in the

State Departments engaged in this work are periodically trained in the tested data collection system and that the CMFRI may arrange and provide such training to the desired staff.

Action to be taken by: Departments of Fisheries / Statistical Bureaus, Governments of maritime States and Union Territories; CMFRI.

3.2 Data Collection by CMFRI

The Workshop,

noting that one of the major objectives of CMFRI is to assess the fish stocks of various species in different regions and furnish this information to be the planners, development agencies and the fishermen/fishing industry, and

considering that it is necessary to monitor the exploited fish populations more intensively and obtain related biological and environmental data to work on stock assessment,

recommends that the concerned Division of CMFRI be strengthened to acheive a coverage of 5% of landing centre-days by the end of the Sixth Five Year Plan.

Action to be taken by: Indian Council of Agricultural Research; CMFRI.

3.3. Catch Statistics

The Workshop,

observing that there are differences in the estimates of resources exploited in the small - scale fisheries sector and that there is considerable delay in finalising the estimates with the concerned Departments of States and

stressing the need for speedy and reliable estimate

recommends that the estimate brought out by the NMLRDC after consultations with the States be accepted as the national estimate and that the said estimate be made available reasonably quickly.

Action to be taken by: Department of Agriculture, Government of India; Departments of Fisheries / Statistical Bureaus, Governments of maritime States and Union Territories; CMFRI.

4.DATA ACQUISITION OF OTHER FISHING ACTIVITIES INCLUDING THE LARGE FISHING VESSELS IN THE EEZ

4.1. Supply of data

The workshop,

appreciating the diversification and extension of fishing operations in the Exclusive Economic Zone to exploit the resources through the operation of different types of gears by the large fishing vessels, including chartered fishing vessels and those operating under different bilateral or multi - lateral arrangements, as also the vessels engaged in exploratory resources surveys, experimental fishing and training,

stressing the importance of acquisition of data on the resources exploited, identified or assessed by those vessels for the development of fisheries of the country,

recommends that all the parties engaged in the above fishing activities shall furnish the data on the exploitation to the NMLRDC at CMFRI; and

further recommends that the Fisheries Division in the Department of Agriculture, Union Ministry of Agriculture may take appropriate measures to ensure that all the larger fishing vessels operated by the Industry, Government, public sector, individual entrepreneurs, chartered vessels and those operating under bilateral and multilateral agreements furnish the data to the NMLRDC and

appeals to the owners of fishing vessels to comply and cooperate in this national effort.

Action to be taken by: Department of Agriculture, Government of India; Public and private sector organisations/companies engaged in marine fishing directly /through charter.

4.2. Modus operandi of data supply

The Workshop,

observing that there is no mechanism at present to obtain these data not withstanding its importance in the national context,

recommends that all the vessels engaged in fishing activities referred to in the recommendation 4.1, should record the data in the prescribed proformae drawn up for differnt types of vessels/operations and accepted in this Workshop which is represented by the Central and State Government representatives, public and private sector organisations, parastatal organisations and research institutes and supply the same to the NMLRDC immediately on conclusion of each voyage and

further recommends that the NMLRDC at CMFRI should make adequate arrangements to supply the required proformae to the fishing oragnisations.

Action to be taken by: Department of Agriculture,

Government of India; public and private sector organisations/companies engaged in marine fishing directly-/through charter; CMFRI.

5. DATA PROCESSING AND STORING

5.1. Data processing, storage and retrieval

The workshop,

stressing that the fishery data obtained from various sources should be properly processed without much time lag for immediate and future use,

observing that it is essential to store the procesed or semi-processed data at the NMLRDC for future use and to retrieve the same as and when required by the user agencies, and

noting that enormous data acruing from different kinds and areas of fishing operations are to be subjected to in-depth analysis.

reiterating the Planning Commissions recommendations that CMFRI should develop a computerised information system,

recommends that the CMFRI be immediately equipped with appropriate electronic computing system to facilitate quick processing of data, their storage and retrieval of information.

Action to be taken by: Indian Council of Agricultural Research; CMFRI.

5.2. Maintaining the confidentiality of data

The Workshop,

noting that different parties are involved in the exploitation of the resources, and

observing that it is essential to maintain the confidentiality of the data/information furnished on the resources exploited by each of the parties,

recommends that the identification particulars be coded to ensure confidentiality.

Action to be taken by: Public and private sector organisations/companies engaged in marine fishing directly/through charter; CMFRI.

6. DISSEMINATION OF DATA

The Workshop,

stressing the importance and need for providing information to the planning and developmental agencies, fishing industry and fishermen on production trend, status of fish stocks, technology, management, and forecasting of fishery prospects,

recommends that the NMLRDC should develop an effective and functional system of disseminating the information periodically and provide consultancy service to all sectors.

Action to be taken by: Indian Council of Agricultural Research; CMFRI.

7. OTHER ACTIVITIES.

7.1. Environmental and meteorological data

The Workshop,

noting that data on environmental parameters such as temperature, atmospheric pressure, wind speed, and other meteorological conditions should not only facilitate successful fishing operation but also aid in forecasting of weather conditions at sea,

recommends that the India Meteorological Department (IMD) may consider providing required meteorological instruments to larger fishing vessels to record these parameters useful to forecast the weather and climatic conditions over sea, and the IMD may provide the necessary advice and specialised service to facilitate fishing operations of these vessels.

Action to be taken by: India Meteorological Department; Public and private organisations / companies engaged in marine fishing directly /through charter; National Institute of Oceanography.

7.2. Data on coastal aquaculture/mariculture.

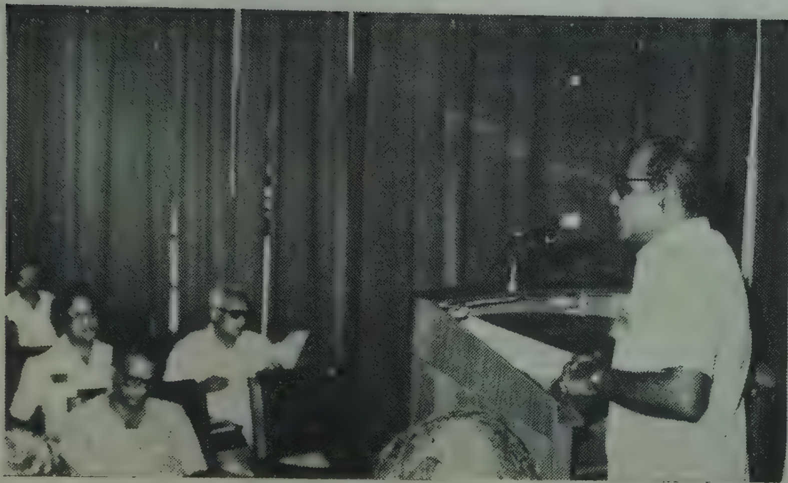
The Workshop,

observing that there is an increasing awareness among the fishermen on the prospects and potentials of aquaculture in coastal saline waters and several of them are entering into this field either on full time basis or part-time basis along with their traditional avocations and

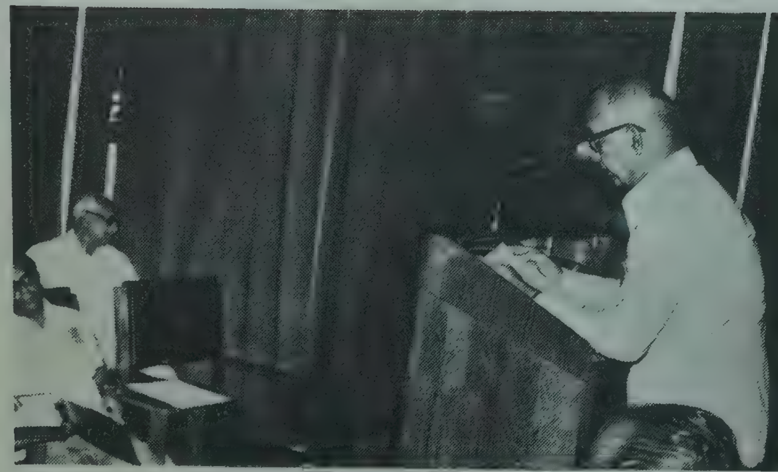
noting that the data on the aquacultural activities taken up by the coastal fishermen and the entreprenuers would be immensely useful to study the impact on the economy of the coastal villages and to study the trend in the development of the fisheries of the region,

recommends that the NMLRDC, besides collecting data on marine fisheries, also collects and analyses the data on coastal aquaculture its economics and social impact.

Action to be taken by: Department of Fisheries, Governments of maritime states and Union Territories; Fisheries Institues of Indian Council of Agricultural Research; Agricultural Universities; Aquaculturists.



Shri T.Jacob, Scientist S-3, CMFRI presenting his lead paper.



Shri G.Venkataraman, Scientist S-3, CMFRI proposing vote of thanks.

7.3. Endangered and rare species

The Workshop,

noting that the populations of certain valuable species in the sea are showing decreasing trend due to exploitation, mortalities and other reasons and some of the endangered species such as the dugong, lesser cetaceans including dolphins and the turtles occur as incidental catch in fishing operations,

stressing that it is essential to conserve those species showing declining population structure through appropriate management and conservation measures,

recommends that all data/information pertaining to resources, exploitation and mortalities due to strandings and incidental catches in fishing operations of endangered marine mammals and turtles be collected and made available to the NMLRDC for analysis and action.

Action to be taken by: World Wildlife-India; Departments of Fisheries, Governments of maritime States and Union Territories; Bombay Natural History Society; Public and private sector organisations / companies engaged in fishing directly/through charter; National Institute of Oceanography; Naval Physical Oceanograpic Laboratory; CMFRI.

FISHERY SURVEY FORM-1

NATIONAL MARINE LIVING RESOURCES DATA CENTRE

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE (ICAR), COCHIN-18.

DAILY RECORD OF CATCH AND EFFORT OF NON-MECHANISED FISHING CRAFTS SHORE SEINES OTHERS

State .... District .... Zone .... Centre ....

Date Period .... No. of shore seines other units landed .... No. of units selected ....

State of sea .... State of sky .... Direction of wind .... Current ....

Serial No.	Allotted No. of selection of units examined	Type of craft		Type of Gear		Length of craft (m)	Absence from shore			Fishing ground				Duration of actual fishing (hours & minutes)	Man power employed	Name, Code and Weight (Kg) of fish landed										Total
		Name	Code	Name	Code		Dep: Time & Date	Arr: Time	Duration of absence (Hrs)	Distance (Km) from the shore	Direction from L.C.	Depth (m)	No. of hauls													
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
															Price per Kg.											

Special attention: Report incidental catch/strandings of cetaceans and turtles with details.

Remarks:

NATIONAL MARINE LIVING RESOURCES DATA CENTRE

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE (ICAR), COCHIN - 18.

DAILY RECORD OF CATCH AND EFFORT OF SMALL MECHANISED FISHING CRAFTS* EXCLUDING PURSE SEINERS

State .... District.................. Zone .... Centre..................

Date Period.......................... Number of units landed.................... No. of units Selected ....

State of sea .... State of sky .... Direction of wind .... Current ....

Serial Number	Allotted No. of selection of units examined	Name and/or craft number	Type of craft		Type of Gear		Length of craft (m)	Horse power	Absence from shore			Fishing ground				Duration of actual fishing (hrs. & minutes)	Man power employed	Av. Trawling speed in case of trawler (km/hr.)	Name, Code and Weight (Kg) of fish landed										Total
			Name	Code	Name	Code			Dep. Time & Date	Arr. Time	Duration of absence (hrs)	Distance (km) from the shore	Direction from L.C.	Depth (m)	No. of hauls														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
											Price in Rs. per Kg:																		

Special attention: Report incidental catch/ stranding of cetasians and turtles with details.

Remarks:

Name & Signature of observer:

*Trawler (A)/Gill netter (B)/Long liner (C)/Dol netter (D)/Country craft with O.B. (E)

FISHERY SURVEY FORM 2F

NATIONAL MARINE LIVING RESOURCES DATA CENTRE

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE, (ICAR), COCHIN - 18.

DAILY RECORD OF CATCH AND EFFORT OF PURSE SEINE BOATS

State .... District .... Zone................ Centre ....

Date Period .... Number of boats landed .... Number of boats selected ....

Fishing Conditions: State of sea ..... State of sky .... Direction of wind. .... Current ....

Serial Number	Allotted no. of selection of units examined	Name and or/craft number	Type of craft		Length of craft (m)	Horse Power	Absence from shore			Fishing ground				Duration of actual fishing (hours & minutes)	Man power employed	Name, Code and weight (kg) of fish landed										Total
			Name	Code			Dep. Time & Date	Arr. Time	Duration of absence (hrs)	Distance (km) from the shore	Direction from the landing centre	Depth (m)	No. of hauls													
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
									Price in Rs. per kg																	

Special attention: Report incidental catch/strandings of cetaceans and turtles with details.

Remarks:

FISHERY SURVEY FORM - 2G

NATIONAL MARINE LIVING RESOURCES DATA CENTRE

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE (ICAR), COCHIN - 18

DAILY RECORD OF CATCH LANDED BY CARRIER BOATS (FROM PURSE SEINE BOATS)

State.............. | District .... | Zone........... | Centre ....

Date | Period .... | Number of boats landed .... | Number of boats selected ....

Serial Number	Allotted no. of selection of units examined	Name and or craft number	Type of craft		Length of craft (m)	Horse power	Absence from shore		Man power employed	Name, Code and Weight (Kg) of fish landed										Total
			Name	Code			Dep. Time	Arr. Time												
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
							Price in Rs. per kg													

Special attention: Report incidental catch/strandings of cetasians and turtles with details.

Remarks:

Name & Signature of observer:

FISHERY SURVEY FORM 2 H

By enquiry:

NATIONAL MARINE LIVING RESOURCES DATA CENTRE

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE, (ICAR). COCHIN-18.

DAILY RECORD OF EFFORT EXPENDED AND CATCH DATA ON PURSE-SEINERS

State .... District .... Zone .... Centre............

Date Period .... Number of purse-seiners operated ....

Serial Number	Name and or craft number	Gear particulars		Length of craft (m)	Horse power	Absence from shore			Number of hauls	Fishing ground			Duration of actual fishing (hours & minutes)	Man power employed	Name, Code and Weight (Kg) of fish landed						REMARKS
		Length (m)	Mesh size (mm)			Dep. Time & Date	Arr. Time	Duration of absence (hrs)		Distance (km) from the shore	Direction from the landing centre	Depth (m)								Total catch	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22

Special attention: Report incidental catch/strandings of cetasians and turtles with details.

Name & Signature of observer:

FORM 3-A

NATIONAL MARINE LIVING RESOURCES DATA CENTRE

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE, (ICAR), COCHIN-18

LARGER MECHANISED VESSELS-TRAWLER

LOG FOR DAILY FISHING OPERATIONS

Name/Code No. of vessel(s) .... Voyage No. .... Method of fishing ....

Base of operation .... Date .... Day of Trip ....

(a) Fishing Conditions

Item → / HAUL NO	Fishing area (Shooting point).		Trawling speed	Direction of trawling	Length of head rope (m)	Mesh size-cod end (mm)	Length of warp (m)	Fishing depth (m)	Bottom depth (m)	Time of		Nature of sea bottom M/S/C/	State of sky B/C/BC/....	State of sea R/S/....	Wind		Current		Temperature sea surface (°C)	Atmospheric pressur
	Latitude	Longitude								Completion of shooting (hrs & mts.)	Commencement of hauling (hrs. & mts.)				Force	Direction	Speed	Direction		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1 Data / Code																				
2																				
3																				
4																				
5																				
6																				
7																				
8																				
9																				
10																				

(b) Catch Details (kg)

	Prawns						Cephalopods		Fish														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Name of species →							Cuttle fish	squids															
Code / Haul No																							Total
1																							
2																							
3																							
4																							
5																							
6																							
7																							
8																							
9																							
10																							
Total																							

(c) Special observations (to be amplified under remarks): Wrecks & obstructions ( ) presence of foreign vessel ( );
Sighting of whales ( ); dolphins ( ); fish shoals ( ); plankton blooms ( ); bird flocks ( );
floating of weeds ( ); pollution ( ); other observation ( )

(d) Fuel consumption: LSD (lit) .... HSD (lit.) .... Lubricating oil (lit.) .... others ....
(to be given at the end of the voyage)

(e) Date of start from base .... Date of return to base .... (to be given at the end of the voyage)

(f) Remarks

Name and signature of skipper

FORM 3-B

NATIONAL MARINE LIVING RESOURCES DATA CENTRE

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE, (ICAR), COCHIN-18

LARGER MECHANISED VESSELS-PURSE SEINER

LOG FOR DAILY FISHING OPERATIONS

Name / code No of vessel(s) .... Voyage No.................. Mesh size (mm)..................................

Base of opertion .... Date .... Day of Trip ....

(a) Fishing Conditions:

Items → / HAUL NO	Fishing area (setting position)		Size of net		Detection V/S/BF	Type of school	Size of school	Scouting period (hrs)	Time of setting (hrs. & mts)	Time of finish (hrs. & mts.)	Fishing depth (m)	Bottom depth (m)	State of sky B/C/BC	State of sea R/S	Wind		Current		Temperature sea surface (°C)	Thermocline		Atmospheric pressure
	Latitude	Longitude	Length (m)	Depth (m)											Force	Direction	Speed	Direction		Top depth (m)	Bottom depth (m)	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1 Data Code																						
2																						
3																						
4																						
5																						
6																						
7																						
8																						
9																						
10																						

(b) Catch Details (kg)

Name of fish	Skipjack	Albacore	Yellow fin																			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Code / HAUL NO																						Total
1																						
2																						
3																						
4																						
5																						
6																						
7																						
8																						
9																						
10																						
TOTAL																						

(c) Special observaions (to be amplified under remarks); Wrecks & obstructions ( ); presence of foreign vessel ( );
Sighting of whales ( ); dolphins ( ); fish shoals ( ); plankton blooms ( ); bird flocks ( );
floating of weeds ( ); pollution ( ); other observations ( )

(d) Fuel consumption: LSD (lit.) .... HSD (lit.) .... Lubricating oil (lit.) .... others .... (to be given at the end of the voyage)

(e) Date of start from base .... Date of return to base .... (to be given at the end of the voyage)

Name and signature of skipper.

FORM 3-C

NATIONAL MARINE LIVING RESOURCES DATA CENTRE

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE, (ICAR), COCHIN-18

LARGER MECHNISED VESSELS-TUNA LONG LINER

FISHING DETAILS FOR EACH OPERATION

Name of vessel .... Voyage No.......................

(a). HYDROGRAPHIC DATA

			Position		Depth of hooks			Temperature		Thermocline		wind		Current		Sea condition			
																Wave			
	Date	Time	Latitude	Longitude	Maximum (m)	Minimum(m)	Bottom depth (m)	Air (°C)	Sea surface (°C)	Top depth (m)	Bottom depth (m)	Direction	Speed	Direction	speed	Direction	Height (cm)	Water Transparancy (m)	Other observations (specify)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Commencement of Shooting																			
End of hauling																			

(b-1).FISHERY DATA

Number of baskets	Total No. of hooks	Baits	Shooting			Hauling		Observations on lines	Catch composition* (Name, code and number of fish)																	Total number	Total Weight
			Direction	From (hrs)	To (hrs)	From (hrs)	To (hrs)		Yellow fin	Skipjack	Albacore																
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28

*Details to be given in separate proforma no (b-2) attached

(c) Special observations: (to be amplified under remarks): Wrecks & obstructions ( ); presence of foreign vessel ( ); sighting of whales ( ); dolphins ( ); fish shoals ( ); plankton blooms ( ); bird flocks ( ); floating of weeds ( ); pollution ( ); other observations ( )

(d) Fuel consumption: LSD (lit.) ....HSD (lit.)............... Lubricating oil (lit.) ....others .... (to be given at the end of voyage)

(e) Date of start from base................. Date of return to base .... (to be given at the end of the voyage).

(f) Remarks:

Name and signature of skipper

NATIONAL MARINE LIVING RESOURCES DATA CENTRE

FORM 3 - C Continued

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE, (ICAR), COCHIN - 18

LARGER MECHANISED VESSELS - TUNA LONG LINER

FISHING DETAILS FOR EACH OPERATION.

(b.2). CATCH DETAILS

Basket Sl. No.	Branch No.	Name of fish	Body length	Weight (kg)	Group Weight (kg)	Remarks

APPENDIX-1

Report of the Working Group for standardisation of proformae for larger mechanised vessels.

The following members participated in the discussions

Commodore K.M.V.Nair, Tata Oil Mills Ltd., Madras, Group Leader.

Dr.A.A.Ramasastry, Deputy Director General, India Meteorological Department, Pune.

Shri.Patabhiraman, Gujarat Agro Industries, Visakhapatnam.

Shri.B.B.Lal, Assistant Commissioner (F.S),New Delhi.

Dr.S.L.Shambhogue, Professor, University of Agri. Sciences, Mangalore.

Shri.P.Sulochanan, Deputy Director, EFP, Cochin.

Shri. P.Ramanujan, Instructor (General), C.I.F.N.E.T.

Lt.Abraham .J.Lucose, Asst. Hydrographer, Dehradun.

Shri.C.K.B.Kurup, Scientist., N.P.O.L.,Cochin.

Shri.K.K.P.Menon, Tata Oil Mills Ltd., Cochin.

Shri.K.H.Mohamed, Scientist S-3, C.M.F.R.I., Cochin-18.

Shri.K.V.N.Rao, Scientist S-3, C.M.F.R.I. Cochin-18

Dr.P.P.Pillai, Scientist S-2, C.M.F.R.I., Cochin-11.

Dr.K.Radhakrishna, Scientist S-2, C.M.F.R.I., Waltair

Shri.T.Jacob, Scientist S-3, C.M.F.R.I., Cochin, Member Secretary.

The draft proformae were considered one by one. The additions/deletions/modifications required to be incorperated in the draft were discussed and finalised. The details are as follows:

I. The draft proforma for *trawlers* was taken up first. The suggestions approved are given below.

1. The proforma should contain (a) an identification number and the frequency of recording on top. (b) The body of the proforma should contain, length of head rope, time of completion of shooting and commencement of hauling, the force and direction/of wind and the atmospheric pressure. Also the location of the area should correspond to the time of shooting.
2. For nature of bottom (muddy/sandy etc), state of sky (B/C/BC/etc) and state of sea (rough / smooth etc.) different alternative should be given to facilitate quick recording of the needed data.
3. In each details, only 2 or 3 major species are to be named under each category. Enough blank spaces may be given to accommodate the rest.
4. Special observations should be retained. The fuel consumption for the voyage should be recorded in the proforma on the last day of the voyage after completion.

   and
5. The summary proforma may be dropped.

II. The draft proformae for tuna *long-liners* were taken next.

1. It was agreed that the proforma should contain (a) the frequency of recording (b) place,date and time of departure and arrival and (c) the hydrographic data both at the commencement of the shooting and end of hauling.
2. Col. heading 'date' and 'fishing area' should be dropped.
3. In the second proforma giving catch details 'sl.no.' could be deleted and instead 'Basket sl. no.' should be given. The col. headed 'Basket no.' may be deleted.

   and
4. Information under special observation and fuel consumption is to be recorded as in the case of trawlers. Summary proforma may be dropped.

III. The draft proformae for *purse-seiners* were considered.

1. It was agreed that the proforma should contain (a) size of net (length & depth) (b) detection (visual / sonar/bird flock) (c) type of school (d) scouting time (e) time of setting and finishing and (f) thermocline (top depth & bottom depth). and
2. Information on 'state of sky' etc. 'special observation' and 'fuel consumption' is to be recorded as in the case of trawlers. Summary proforma should be dropped.

IV. General

1. The details regarding H.P., length etc. should be obtained by CMFRI by contacting D.G.Shipping / MPEDA/Ministry of agriculture.
2. The proforma should be recast taking care of these observations and also the requirements for transferring data to cards/tapes for feeding in the computers.

(T.Jacob)
Member Secretary

Report of the Working Group for standardisation of proformae for smaller mechanised vessels.

The following are the members in the committee

Shri.V.Ramamurthy, I.A.S., Commissioner of Statistics, Tamilnadu, Group Leader.

Shri.Vijay Ranchan, I.A.S., Commissioner of Fisheries, Gujarat.

Dr.M.Devaraj, Professer (FB) C.I.F.E. Bombay.

Shri.H.Krishna Iyer, Scientist S-2, C.I.F.T., Cochin.

Shri.B.V.Subramanyan, Asst. Director of Fisheries, Karnataka.

Dr.Kuruvilla Mathew, Lec. Dept. of Industrial Fisheries, University of Cochin.

Dr.S.V.Bapat, Joint Director, C.M.F.R.I., Cochin-18.

Dr.M.J.George, Scientist S-3, C.M.F.R.I., Cochin-18.

Dr.A.V.S.Murthy, Scientist S-3, C.M.F.R.I., Cochin-18.

Dr.K.Alagaraja, Scientist S-2, C.M.F.R.I., Cochin-18, Member Secretary.

While leading the discussions the members suggested the following.

1. Atleast 10 units should be observed, once the number of units landing is more than 10. In case of 10 and less than 10 units landing, all units are to be observed as usual.
2. In form-1A, the following modifications may be incorporated.
   i. In the third horizontal line from the top, information on state of sea etc is required. This mens that this information is supposed to be the same for all units landing on that day which may not be true. Though variations in the above said information may be there for the same unit from haul to haul, atleast an over all idea on the condition of sea etc.for a unit can be had instead of for the centre as a whole. Hence Shri. Ramamurthy suggested that this row can be brought down columnwise against each unit observed. Members also agreed for this change.
   ii. The title for column 2 may be rewritten as 'allotted number of selection of units examined'
   iii. Under column 13 the title may be modified as "Distance (km) of fishing ground and direction".
   iv. Duration of actual fishing may be indicated in hours and minutes under column 16.
   v. In the place of 'man power employed' in column 17 'No. of persons on board' may be substituted.
   vi. Extra columns for noting down oil consumption for each boat indicating name of oil and quantity (l) consumed for the trip may be given.
3. Regarding Form-1B meant for both mother boats (Purse-seiners) and carrier boats, it is suggested that separate forms for mother boats 1 B and carried boats 1 C may be maintained. For this purpose in the new form 1 B meant for purse seine the changes suggested in form 1 A may be carried out, and the term 'for mother boat' may be excluded. New form 1 C for carrier boats has been prepared by Dr.K.Alagaraja, member secretary and placed before the working group on 22-10-'82 which was accepted. And
4. The earlier form 1 C meant for collection of data on effort on enquiry for Purse seine operations has been numbered as form 1 D. For this form also, the suggestions made for earlier forms are to be incorporated.

On 23-10-'82, when the points discussed in the final session for concurrence of all members, it was decided that status quo for the 3rd row about fishing conditions in form 1 A and 1 B may be maintained and due to the hardships faced at present by the field staff in collecting data, extra burden for collecting data on fuel consumption need not be given. All the other suggestions have been recommended and on this basis Forms 1 A, 1 B, 1 C & 1 D were prepared and enclosed.

(K.Alagaraja)
Member Secretary

Report of the Working Group for standardisation of proformae for non-mechanised crafts.

The following members participated in the discussion.

Shri.R.Srinivasan, Joint Director, Dept. of Fisheries, Madras, Group Leader.

Shri.P.V.Krishnam Raju, Deputy Director, Andhra Pradesh.

Shri.M.G.Naik, Research Assistant (Stat.) Union Territory of Goa, Daman & Diu.

Shri.S.G.Dalal, Scientist N.I.O., Goa.

Shri.M.K.Sankaran Kutty, Asst. Director (Statistics) Dept. of Statistics, Tamilnadu.

Shri.K.Koya, Statistical Assistant, Govt. of Lakshadweep, Kavarathy.

Shri.Mhaiskar, Senior Statistical Officer, Dept. of Fisheries, Govt. of Maharashtra.

Dr.P.V.Rao, Scientist S-3, C.M.F.R.I.,Cochin.

Dr.B.Krishnamoorthy, Scientist S-3, C.M.F.R.I., Madras.

Shri.G.Parasuraman, Assistant Director of Fisheries, Tamil Nadu.

Shri.G.Venkataraman, Scientist S-3, C.M.F.R.I., Cochin-18, Member Secretary.

Shri.K.Krishna Rao, Scientist S-2, C.I.F.T., Cochin.

The working Group formed to examine the proforma meant to record details of catch and effort of non-mechanised fishing crafts considered the form in detail and unanimously approved the proforma with the following modifications/details.

1. In col.3 and col.7 the word 'boat' may be substituted by 'craft'
2. Additional column can be given to indicate the fishing ground and properly coded.

(R.Srinivasan)
Group Leader.

APPENDIX- 2

COMMITTEES CONSTITUTED FOR THE CONDUCT OF THE WORKSHOP

1. Transport and Accommodation Committee

Shri.S.K.Dharma Raja-Convener.

Members: S/Shri.R.Sathiadas, M.Srinath, U.K.Sathyavan, Varughese Jacob and P.K.Mahadevan Pillai.

2. Secretarial Committee.

Shri.T.Jacob-Convener.

Members: S/ Shri.K.N.Kurup, K.Balan, M.Srinath, K.K.Datta and Smt.Krishna Srinath and Smt.K.Vijayalekshmi.

3.Conference Hall Amenities Committee

Shri.G.Venkataraman-Convener.

Members: S/Shri.D.B.S.Sehara, K.K.P.Panikkar, C.R.Shanmughavelu, S.Natarajan, G.Balakrishnan, V.Rajendran, P.Sivaraman and Haja Najeemudeen.

4. Finance Committee

Dr.K.Alagaraja-Convener

Members: S/Shri.K.Balan, R.Sathiadas and K.C. Yohannan.

APPENDIX - 3

PARTICIPANTS

Sl.	Name	Designation and Address.
1.	Abraham J. Lucose	Asst. Hydrographer, Naval Hydrographic Office, Dehra Dun.
2.	Alagaraja, K.	Scientist S-2, C.M.F.R.I., Cochin-18.
3.	Balan, K.	Scientist S-1 C.M.F.R.I., Cochin-18.
4.	Bapat, S.V.	Joint Director, C.M.F.R.I., Cochin-18.
5.	Dalal, S.G.	Scientist, N.I.O., Goa.
6.	Desai, A.D.	Asst. Director of Fisheries, (Statistics), Government of Gujarat, Ahmedabad.
7.	Devaraj, M.	Professor, C.I.F.E., Bombay.
8.	Dharma Raja, S.K.	Scientist S-2, C.M.F.R.I., Cochin-18.
9.	George, M.J.	Scientist S-3, C.M.F.R.I., Cochin-18.
10.	Hridayanathan, C.	Lecturer, Dept. of Industrial Fisheries, Cochin-16.
11.	Jacob, T	Scientist S-3 C.M.F.R.I., Cochin-18.
12.	Kartha, K.N.K.	Scientist S-2, C.M.F.R.I., Cochin-18
13.	Koya, K.	Statistical Assistant, Govt. of Lakshadweep, Kavarathy.
14.	Krishna Iyer, H.	Scientist S-2, C.I.F.T., Cochin-29
15.	Krishnamoorthy, B.	Scientist S-3, Officer-in-charge, Madras Research Centre of CMFRI, Madras.
16.	Krishnam Raju, P.V.	Deputy Director of Fisheries, (Statistics), Dept. of Fisheries, Government of Andhra Pradesh, Hyderabad.
17.	Krishna Rao, K.	Scientist S-2, C.I.F.T., Cochin-29.
18.	Kurup, C.K.B.	Scientist-C, N.P.O.L., Naval Base, Cochin-4
19.	Kurup, K.N.	Scientist S-1, C.M.F.R.I., Cochin-18.
20.	Lal, B.B.	Asst. Commissioner, (Statistics)

		Ministry of Agriculture, New Delhi.
21.	Mathew, K.	Lecturer, Dept. of Industrial Fisheries, Cochin-16.
22.	Menon, K.K.P.	Tata Oil Mills Ltd., Cochin.
23.	Mhaiskar, J.D.	Statistical Officer, Dept. of Fisheries, Govt. of Maharashtra, Bombay-2.
24.	Mohamed, K.H.	Scientist S-3, C.M.F.R.I., Cochin-18.
25.	Murthy, A.V.S.	Scientist S-3, C.M.F.R.I., Cochin-18.
26.	Naik, M.G.	Research Assistant, (Statistics) Directorate of Fisheries, Govt. of Goa, Daman & Diu., Panaji, Goa.
27.	Nair, K.M.V.	Tata Oil Mills Ltd., Madras
28.	Nair, N.V.	Asst. Director of Fisheries, Govt. of Kerala, Trivandrum.
29.	Parasuraman, G.	Asst. Director of Fisheries, (Statistics), Govt. of Tamil Nadu, Madras-6.
30.	Pattabhiraman, C.	Operations Manager, Gujarat Agro Marine Products, Visakhapatnam (A.P.)
31.	Pillai, P.P.	Scientist S-2, C.M.F.R.I., Cochin-18.
32.	Pillai, S.S.	Joint Director, I.A.S.R.I., New Delhi.
33.	Pillai, V.N.	Deputy Director, I.F.P., Cochin.
34.	Radhakrishna K.	Scientist S-2, Officer-in-charge, Waltair Research Centre of CMFRI, Waltair.
35.	Ramalingam, V.	Joint Director, M.P.E.D.A., Cochin-16.
36.	Ramamurthy, V.	Commissioner of Statistics, Govt. of Tamil Nadu, Madras-6.
37.	Rao, K.V.N.	Scientist S-3, C.M.F.R.I., Cochin-18.
38.	Rao, P.V.	Scientist S-3, C.M.F.R.I., Cochin-18.
39.	Sastry, A.A.R.	Deputy Director General, I.M.D., Pune-5.
40.	Sankaran Kutty, M.K.	Asst. Director of Statistics, Govt. of Tamil Nadu, Madras-6.
41.	Samuel, C.T.	Professor, Dept. of Industrial Fisheries, Cochin-18.
42.	Sathiarajan, R.	Director, I.F.P., Cochin-16.
43.	Sehara, D.B.S.	Scientist S-2, C.M.F.R.I., Cochin-18.
44.	Shahul Hameed, M.	Reader, Dept. of Industrial Fisheries, Cochin University, Cochin-16.
45.	Shanbhogue, S.L.	Professor, College of Fisheries, Mangalore.
46.	Silas E.G.	Director, C.M.F.R.I., Cochin-18.
47.	Srinath, M.	Scientist S-1, C.M.F.R.I., Cochin-18.
48.	Srinivasan, R.	Joint Director, Dept. of Fisheries, Govt. of Tamil Nadu, Madras.
49.	Subramanyan, B.V.	Asst. Director of Fisheries, (Statistics) Govt. of Karnataka, Bangalore.
50.	Sulochanan, P.	Deputy Director, E.F.P., Cochin.
51.	Swaminath, M.	Director, C.I.F.N.E.T Cochin-16.
52.	Venkataraman, G.	Scientist S-3. C.M.F.R.I., Cochin-18.
53.	Vijay Ranchan,	Commissioner of Fisheries, Govt. of Gujarat, Ahemadabad.

Compiled and prepared by M.J. George, G. Subbaraju and S.K. Dharmaraja.
Published by Dr. M.J. George, Senior Scientist on behalf of the Director, Central Marine Fisheries Research Institute, Cochin-682 018. Phototypeset and printed at PAICO, Cochin 31.

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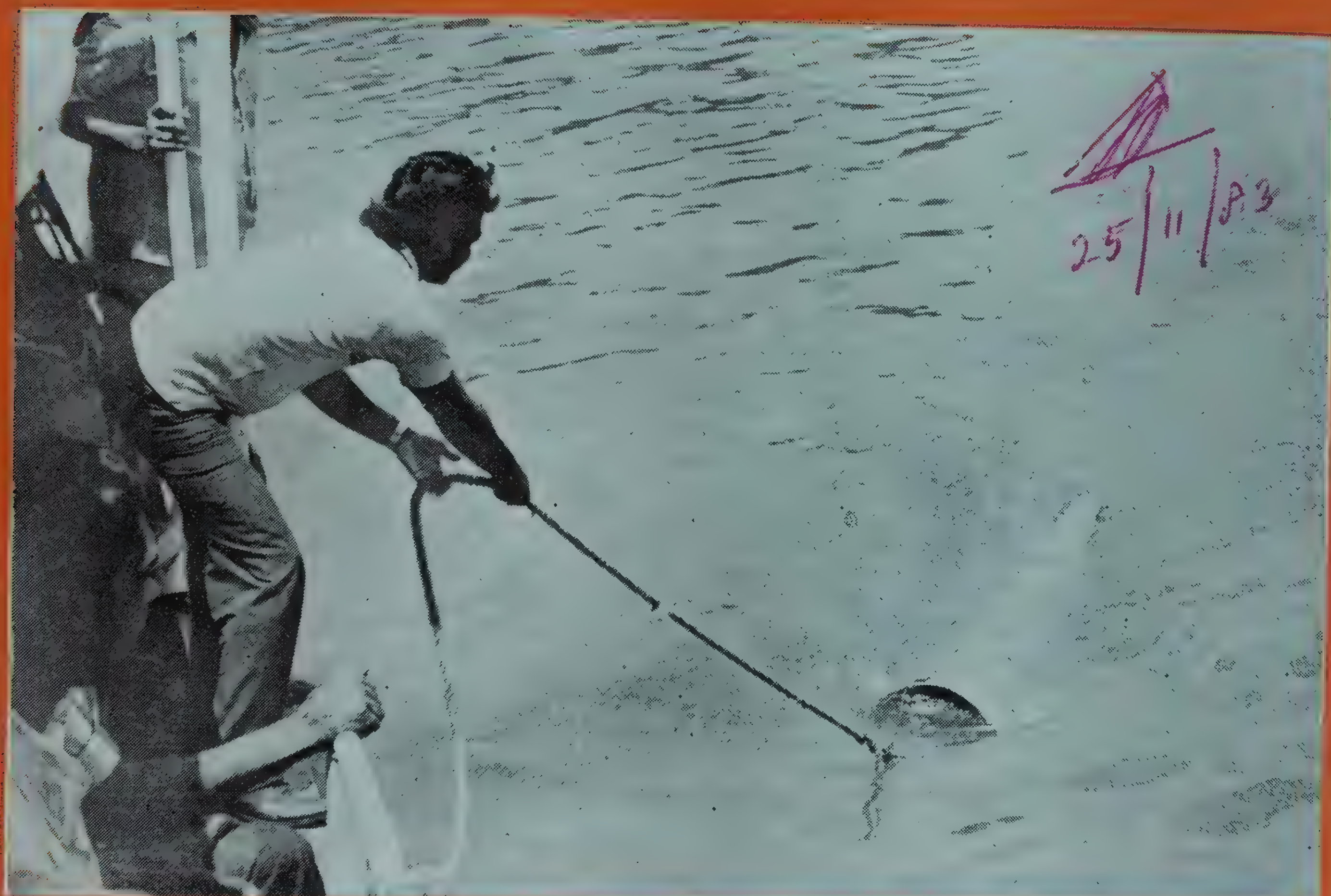

25/11/83

Technical and Extension Series

No. 47

BRUARY, 1983

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE

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THE MARINE FISHERIES INFORMATION SERVICE: Technical and Extension Series envisages the rapid dissemination of information on marine and brackish water fishery resources and allied data available with the Fishery Data Centre and the Research Divisions of the Institute, results of proven researches for transfer of technology to the fish farmers and industry and of other relevant information needed for Research and Development efforts in the marine fisheries sector.

Abbreviation— *Mar. Fish. Infor. Serv. T & E Ser.*,No. 47 : 1982.

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Cover Photo: Collection of samples for studies in secondary production.

TRENDS IN SECONDARY PRODUCTION IN THE INSHORE WATERS OF THE SEAS AROUND INDIA

By K.G. Girijavallaban, S. Krishna Pillai, R. Marichamy, C.V. Mathew, T.S. Naomi, Pon Siraimeetan, K. Ramachandran Nair, Rani Mary Jacob, G.Subramanya Bhat, and K.J. Mathew.

Introduction

The availability of the right forage organisms, their quality and quantity, play a vital role in the sustenance of the living resources of the marine environment. Again, these microscopic organisms which belong to the categories of phyto and zooplankton being a reliable tool for the identification of areas prone to industrial and natural pollution and for understanding its extent and intensity, especially in the inshore areas, the studies on them have added significance. With these in view the Central Marine Fisheries Research Institute has been monitoring the inshore waters at selected centres along the indian coasts, for the seasonal variations in the rate of production at the primary as well as the secondary levels. Such studies help in foretelling any alarming situations developed in the living environment that may affect the commercially important resources adversely.

The following is an account of the pattern of the occurrence and abundance of zooplankton along the Indian coasts from Bombay on the west coast upto Madras on the east coast. Regular weekly or fortnightly samples of zooplankton were collected from fixed stations as surface tows for 10 minutes using a half metre ring net made of nylobolt of 0.4 mm mesh size. The estimates were made as number per 10 minutes haul for all the centres except Vizhinjam where the estimates were made as number per 100 m^3 of water. The samplings were carried out from motor boats at Bombay, Tuticorin, Mandapam and Madras. At Vizhinjam a catamaran was used for making the collections and at other centres country crafts were used for the purpose of plankton collections.

1. Bombay (Fig.1)

In the Bombay waters a study of the annual mean values of zooplankton production during the 3 year period from 1979 to 1982 showed that from a minimum of 3.32 cc per 10 mts. haul in 1979–80 the production of zooplankton rose to 8.43 cc in 1980 – 81 and to 8.08 cc in the subsequent year. Thus it may be stated that the trend in zooplankton production was almost stationery during the latter 2 years. However, the collections could not be made during the southwest monsoon months in the year 1981–82.

The temperature and salinity seemed to have some correlation with the abundance of zooplankton and it was observed that the highest value for plankton was obtained when the salinity was above 35 0/00 in January, 1982. But similar high values of salinity during February and March, 1982 did not coincide with a high yield of plankton. While the temperature showed a gradual decline from October, 1981 to January, 1982, the zooplankton became more abundant and as it went up again the signs of decline in production were noticed. The dissolved oxygen was always on the high rate.

In the plankton samples of the different months the copepods were the highly dominating group and their dominance reached as high as 97.47 per cent in April, 1981. In the other months also their percentage was of the order of 85.52 per cent in March, 1982 and 97.10 per cent in the previous month. The next in abundance was chaetognaths which constituted between 1.58 per cent in February, 1982 and 6.77 per cent in November, 1981 among the other. The decapod larvae contributed from 0.09 per cent in April, 1981 to 3.27 per cent in November, 1981. The above were the three groups whose representatives were present in all the months of sampling. Other zooplankters included medusae, pleurobrachia, lucifer, pteropods, appendicularians and fish eggs and larvae. Most of these groups occurred in the plankton during the period from October to December, 1981.

2. Karwar (Fig.2)

The annual mean values of production at the secondary level showed a declining trend during the 3 year period from 1979. While the mean value for 1979–80 was as much as 9.58 cc per 10 mts. haul it was only 6.78 cc in 1981–82.

The occurrence and abundance of zooplankton in the inshore waters of the Karwar coast were greately influenced by the environmental parameters especially the temperature and the salinity. The density of zooplankton was least during July–August period when the salinity was 6.56 and 5.58 0/00 respectively. Similarly, the lowest temperatures were also noticed during this period, being 26.4 °C and 25.7°C respectively. However, the temperature was

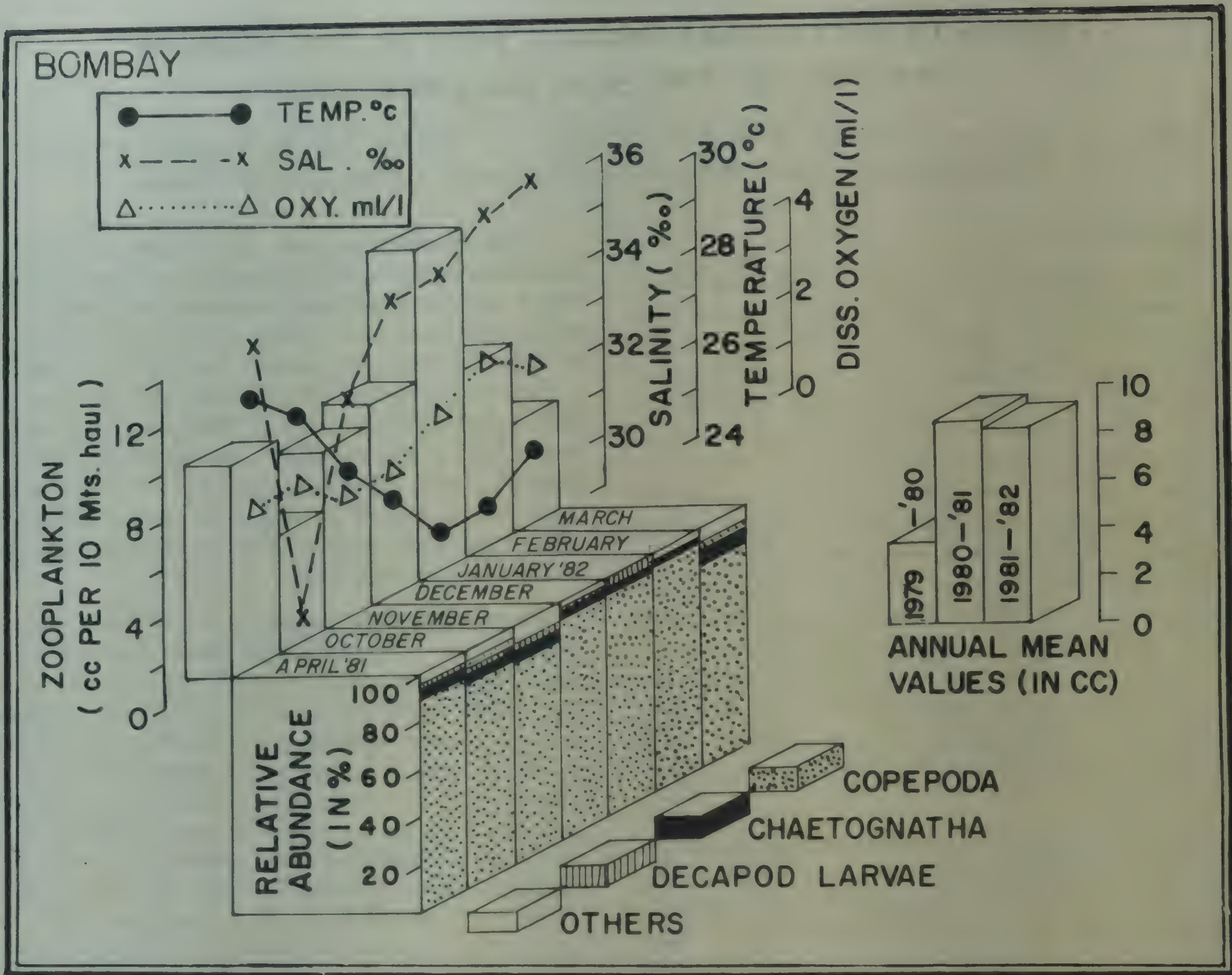


Fig. 1. Trends in secondary production at Bombay

not found to be a limiting factor as the highest value for zooplankton density was obtained in October when the average temperature was 26.6°C. In September eventhough the salinity showed considerable increase, the zooplankton value was low. The dissolved oxygen content of the water was always on the high and therefore it influenced the plankton to the least extent. The premonsoon period from January to April was found to be the most favourable season for the zooplankton in this area. The highest value for zooplankton production observed in October was mainly due to the swarming of the cladocerans.

The monthly variations in the relative abundance among the different groups of zooplankters presented a highly variable picture. The copepods dominated over the others in 8 months. Altogether 12 groups were represented by adults while the larval forms of 9 groups were obtained. The major groups represented in the plankton were copepods, cladocerans and decapod larvae. Eighteen other groups were also represented but in smaller quantities. Occasionally some of these groups swarmed the area and this was particularly observed with the cladocerans and the larvae of cirripede.

The zooplankton groups which were represented by smaller quantities included appendicularians, chaetognaths, lucifer, medusae, siphonophores, salps doliolids, ctenophores, mysids, amphipods and the larvae of copepods, cirripedes, polychaetes, bryozoans, brachiopods, echinoderms, molluscs and fishes The fish eggs were present in all months but were relatively more during the postmonsoon period. It was maximum in November when 29.49 per cent of the total zooplankton was constituted by them. The fish larvae were also relatively more in November when 22.41 per cent was present.

3. Calicut (Fig.3)

In the Calicut area the zooplankton collections were made during the premonsoon and the post

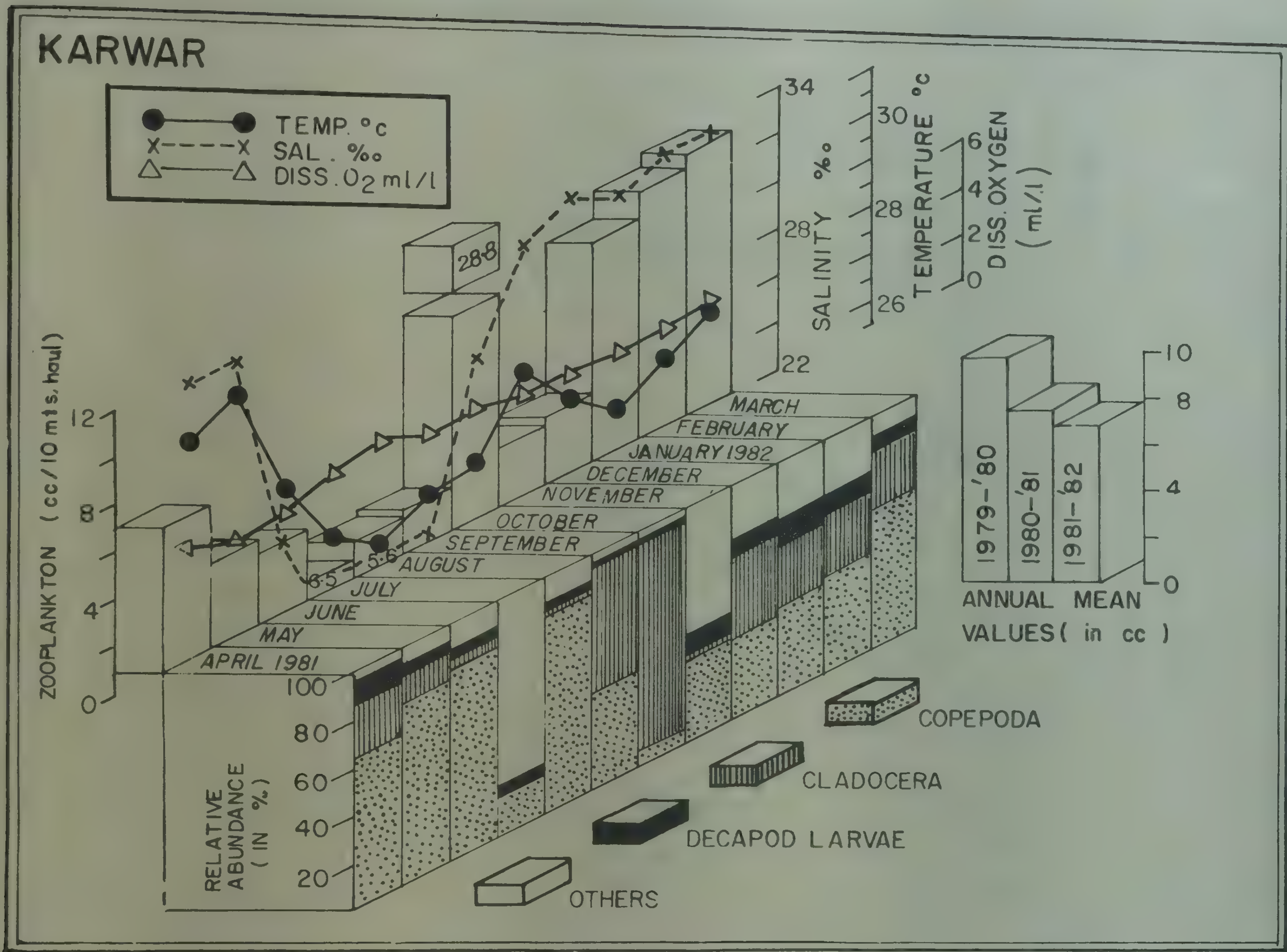


Fig. 2. Trends in secondary production at Karwar.

monsoon months only. As far as the annual fluctuations in the availability of plankton was concerned it came down from a peak of 7.3 cc per 10 mts. haul in 1980 to 3.1 cc in 1981-82. In the previous years of 1977 to 1979 also the density of zooplankton was relatively less.

The monthly variations in the quantitative occurrence of zooplankton were found to be directly correlated with the hydrological parameters, especially the temperature and the salinity. The temperature was found to be a limiting factor on the abundance of zooplankton. It was observed that there was a rhythmic oscillation in the abundance of zooplankton in accordance with the rise and fall of temperature, they being more whenever the temperature registered higher values. The highest quantity of 7.2 per 10 mts. haul was obtained in May, 1981 when the temperature was at the highest (31°C). Similarly, in the case of salinity also its increased values generally favoured a high production of zooplankton in the Calicut area. During the premonsoon months of April and May, 1981 when the salinity was above 35 0/00, the all time increase of zooplankton of the year was noticed. There was noderth of dissolved oxygen in the water in any of the months and therefore it had no role in the fluctuations in the rate of secondary production.

A consideration of the various zooplankton groups which occurred in the different months showed that more groups were present during the summer months of March and April. Cpoepods and chaetognaths were present in all the months of observations. The decapod larvae were absent in January, 1982 only. The other groups which were present in one month or the other were siphonophores, ostracods, appendicularians and eggs of invertebrates and fishes. In all the months the copepods dominated over the others forming 87.68 per cent in April, 1981 to 96.88 per cent in March, 1982. The chaetognaths always ranged between 0.71 per cent in March to 2.95 per cent in January, 1982. The ostracods although were poorly represented constituted 5 per cent of total plankton in November, 1981. Similarly, the decapod larvae also were relatively more in April, 1981 with a share of 6.35 per cent. The other groups of

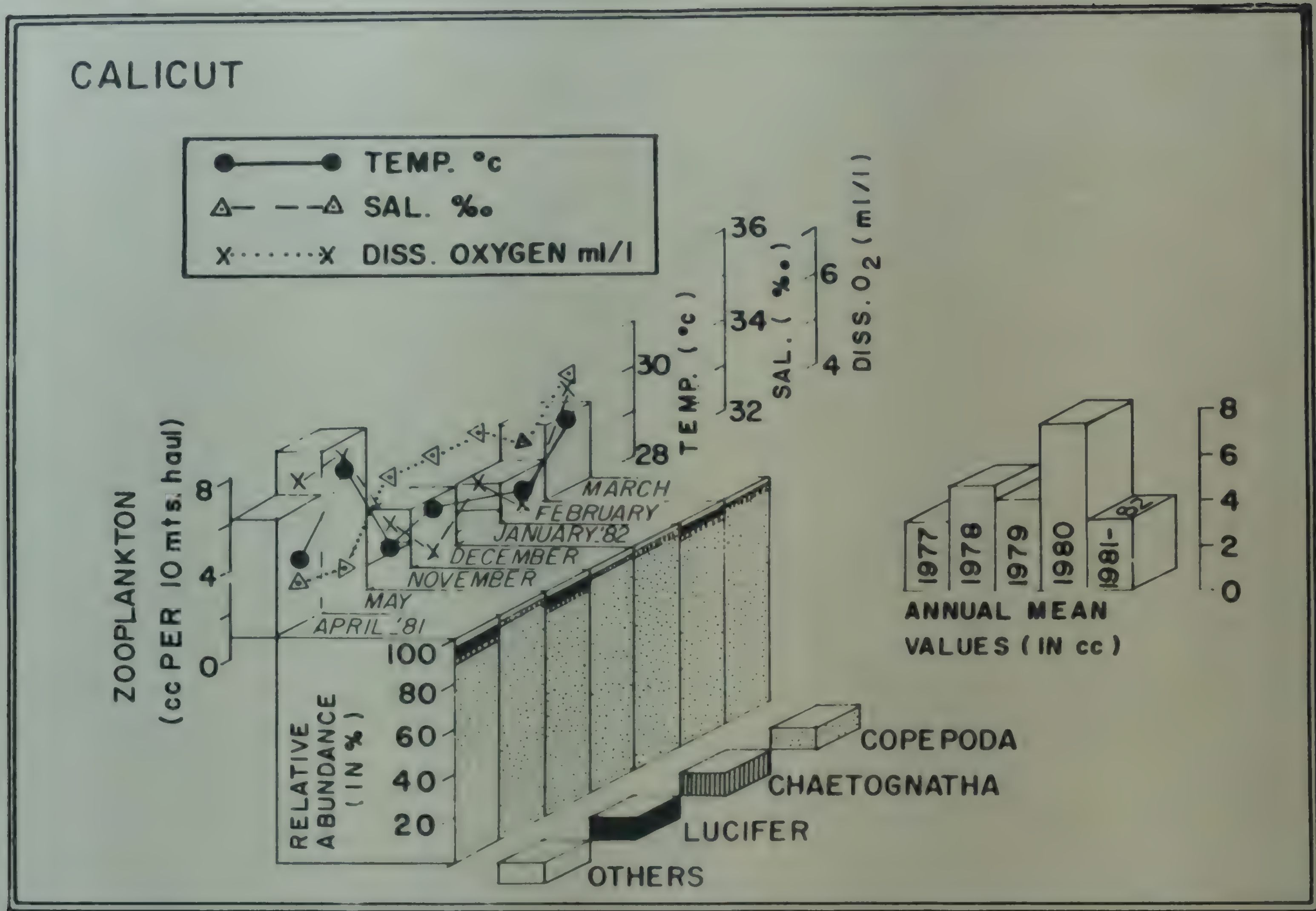


Fig. 3. Trends in secondary production at Calicut.

plankters when present constituted around 1 per cent of the total plankton.

4. Vizhinjam (Fig.4)

At Vizhinjam there was a mixed trend in the rate of production at the secondary level. The highest production was observed in April, 1981 when the average production was 31.05 cc per 100 m^3 of water. A sudden decline in zooplankton production was followed in the next month, when the lowest value of the year. 1981-82 (7.6 cc/10 mts haul) was recorded. From then onwards the alternate rise and fall in density of plankton was experienced at this centre. However, a proper correlation was not found between the plankton abundance and the hydrological features nor did the trend in production follow the changes in the climate. The least values in temperature and salinity were noticed in June, 1981 when the average plankton value was 18.47 cc per 100 m^3 of water. In the other months the temperature and salinity were more or less steady and were centered around 28.5°C and 34.5 0/00 respectively. On the other hand the zooplankton volume fluctuated over a wide margin in every month irrespective of the steady nature of the temperature and salinity values.

As far as the different groups of zooplankton were concerned the copepods dominated which were distantly followed by chaetognaths and decapod larvae. The relative abundance of the copepods among other plankters ranged between 58.71 per cent in June, 1981 and 91.93 per cent in the next month. The other groups were relatively less. The decapod larvae came next in abundance and their maximum of 18.14 per cent among the other zooplankters was observed in March, 1982. They were relatively less in the other months being contributed by 0.47 per cent in September to 5.58 per cent in April. The next in importance was chaetognaths which, however, contributed a small percentage of the total plankton. Thus while their maximum abundance was of the rate of 5.97 per cent in May they were representated in March, 1982 by a mere 0.13 per cent.

5. Tuticorin (Fig. 5)

The annual mean values in secondary production for a period of five years from 1977-82 showed that it maintained a rather steady nature with slight fall in 1978-79 and 1979-80. The 1981-82 value was found to be a little less than that of the previous year.

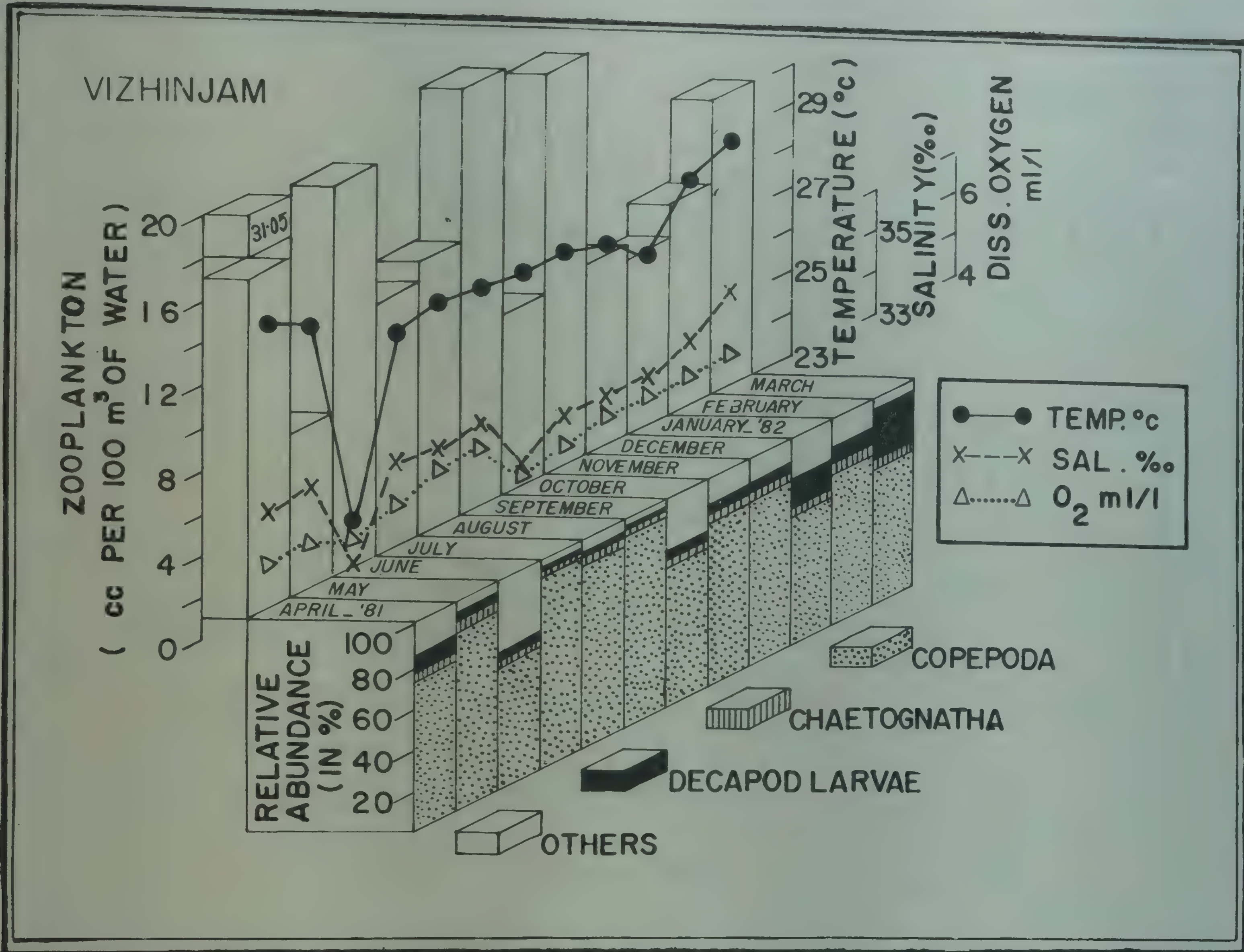


Fig. 4. Trends in secondary production at Vizhinjam.

The temperature ranged from 25.3°C in December, 1981 to 31.6°C in April, 1981. The range in salinity was from 29.93 0/00 in December, 1981 to 34.05 0/00 in March, 1982. The dissolved oxygen content always maintained higher values. The lowering of the temperature and salinity in December due to the northeast monsoon did not affect the overall production of zooplankters adversely. A quantity of 16.0 cc per 10 mts. haul was obtained in this month. However, in the following month when the temperature and salinity remained very low, the quantity of zooplankton came down to as low as 6.2 cc. In general a direct relationship was not noticed between the zooplankton abundance and the hydrological parameters.

One notable feature with regard to the relative abundance of various zooplankton groups in the Tuticorin waters was that the copepods never constituted a major group which was not the case in the other centres. Here their percentage in numerical abundance among the other groups came down as low as 6.0 in November, 1981 and except in May, August and September when they were over 80 per cent, their values were centred around 40 per cent or even less than that. This was mainly due to the sudden swarming of some group of plankters in certain months. Thus for example in November, 1981, 73.5 per cent of the zooplankton was constituted by decapod larvae and such a dominance had reduced the percentage of copepods to 10 per cent. Somewhat similar dominances of larvae of decapods were noticed in July, 1981 and February, 1982 also. A swarm of cladocerans appeared in April, 1981 when 45.7 per cent of the total zooplankton was composed of them. Lucifer was another group which contributed to the bulk of the plankton in July and December, 1981 and January, 1982. Similarly the pteropods dominated over all the other groups in December, 1981. The fish eggs and larvae were relatively more in January–March period.

6. Mandapam (Fig. 6)

The average values of zooplankton production in the Mandapam waters showed a highly declining

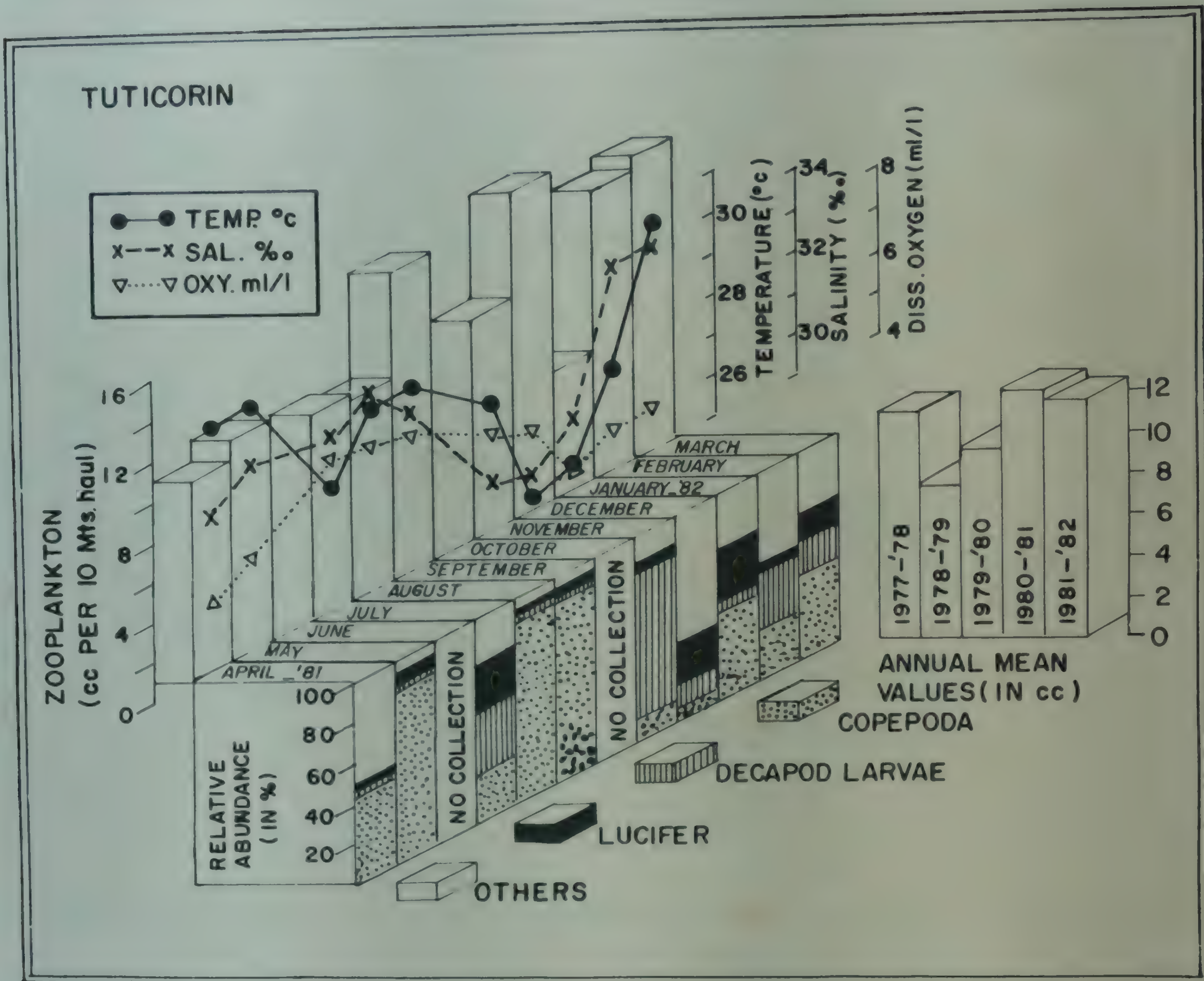


Fig. 5. Trends in secondary production at Tuticorin.

trend from 1979 to 1982. In the 3 years, the rate observed was 18.03 cc, 14.88 cc and 5.46 cc respectively per 10 mts. surface haul.

The monthly mean production of zooplankton during 1981-82 as given in the figure showed a close affinity to the changes in the hydrological features. The general trend was that whenever the temperature and salinity values rose there was a corresponding increase in the quantum of zooplankton. The dissolved oxygen content had no direct relationship with the abundance of zooplankton. Any sudden fluctuation in the quantitative distribution of zooplankton was not noticed in this centre except during November, 1981 and February, 1982 when the displacement volume of plankton was 8.2 cc and 12.3 cc respectively. In the other months it varied between 2.9 and 6.9 cc only with the lowest value in April, 1981.

A groupwise analysis of the major zooplankters for their relative abundance showed that the copepods ranged between 38.8 per cent in March, 1982 and 75.0 per cent in December, 1981 and January, 1982. The fish eggs constituted an important item in the plankton occurring in all the months, and in March, 1982 its number even surpassed that of the copepods. The chaetognaths were also abundant in all the months of observations. Eleven other groups were present in the plankton of the area, the important ones among them being chaetognaths, Lucifer, appendicularians and pteropods. However, these were not regular in their occurrence.

7. Madras (Fig. 7)

In Madras as far as the annual mean production of zooplankton was concerned an alternate pattern of decrease and increase was observed from 1977 onwards, the trend of decreasing or increasing being towards lower values. Therefore in the Madras waters the lowest of the mean production in the last 5 years was experienced in 1981-82 period with a quantity of

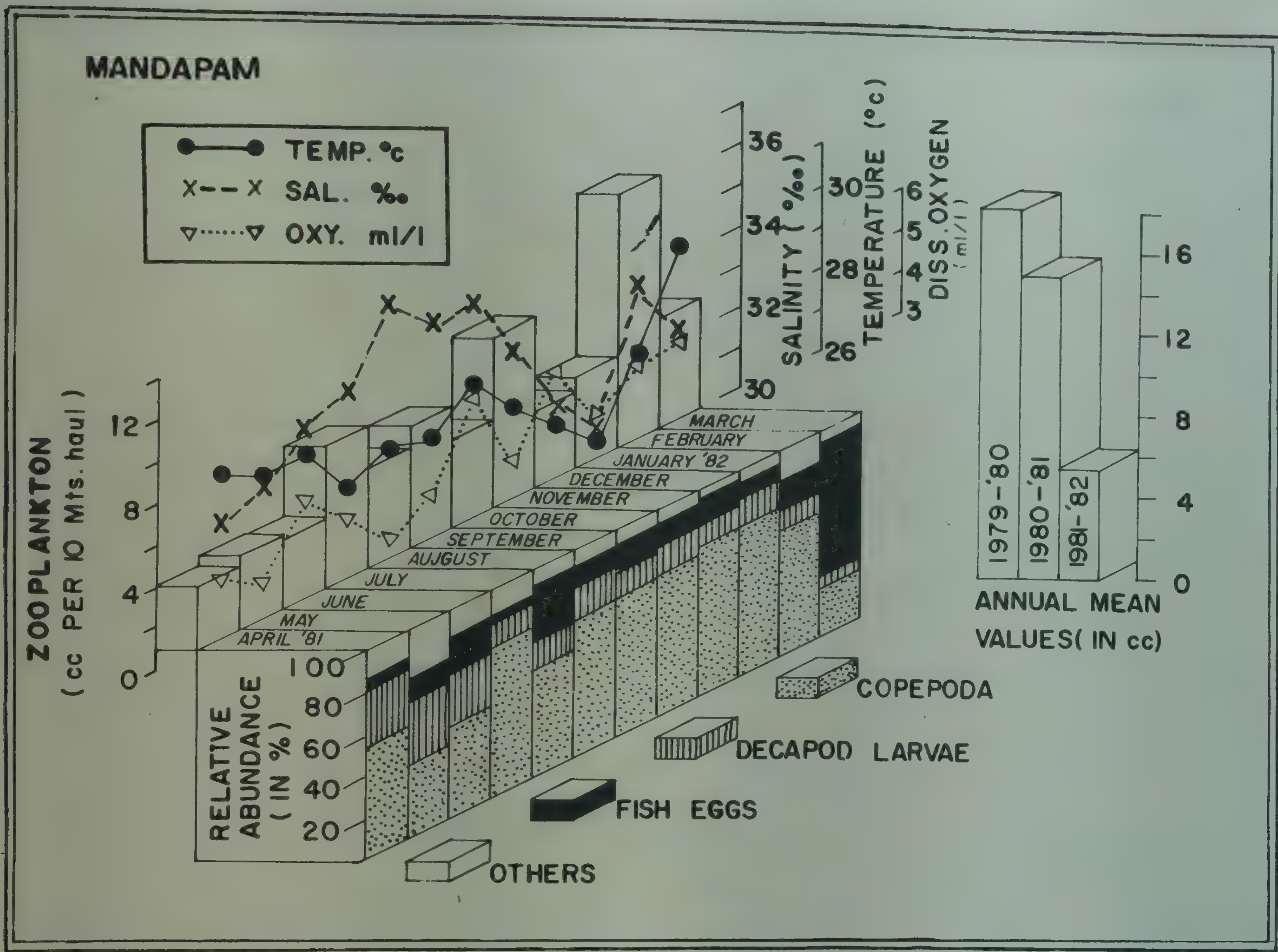


Fig. 6. Trends in secondary production at Mandapam.

5.94 cc per 10 mts. haul. The year of maximum production was 1978 when 13.95 cc of plankton per 10 mts. haul was obtained.

The monthly mean values for the year 1981-82 were found to be always moderate between 2 and 6 cc except in April, 1981 and February, 1982 when higher values at the rate of 16.4 cc and 11.0 cc respectively per 10 mts. haul were obtained. During the northeast monsoon period of November-January the quantum of plankton obtained was low. The environmental parameters such as the temperature, salinity and oxygen were found to have a direct correlation with the plankton abundance. It was generally found that an increase in any of these parameters always favoured an increased availability of the zooplankton.

The percentage composition of the major groups of plankters showed that the copepods formed the main constituent in all the months. Their quantity among others ranged between 43.39 per cent in April, 1981 and 82.13 per cent in October, 1981. Next to copepods the chaetongnaths and decapod larvae dominated the plankton almost equally, but with variations in the different months. While the chaetognaths were absent in the plankton in December, 1981, the decapod larvae were absent in August and October, 1981 and March, 1982. Apart from these, 13 more groups comprised by medusae, siphonophores, Lucifer, amphipods, appendicularians, salps and doliolids, fish eggs etc were also present in the plankton.

Remarks:

In general the rate of secondary production on the west as well as on the east coasts during the 1981-82 period was comparatively lesser than during the previous year. It was more pronounced in Calicut Mandapam and Madras. In Madras, the year 1981-82 was the period of least production in the previous 5 years. Similarly in Mandapam the 1981-82 value was the lowest ever obtained during the previous 3 years time. In Madras in the last 5 year period the year 1978 registered the maximum production. But since then the trend was on the declining side until 1981-82 eventhough a slight increase was noticed in 1980-81

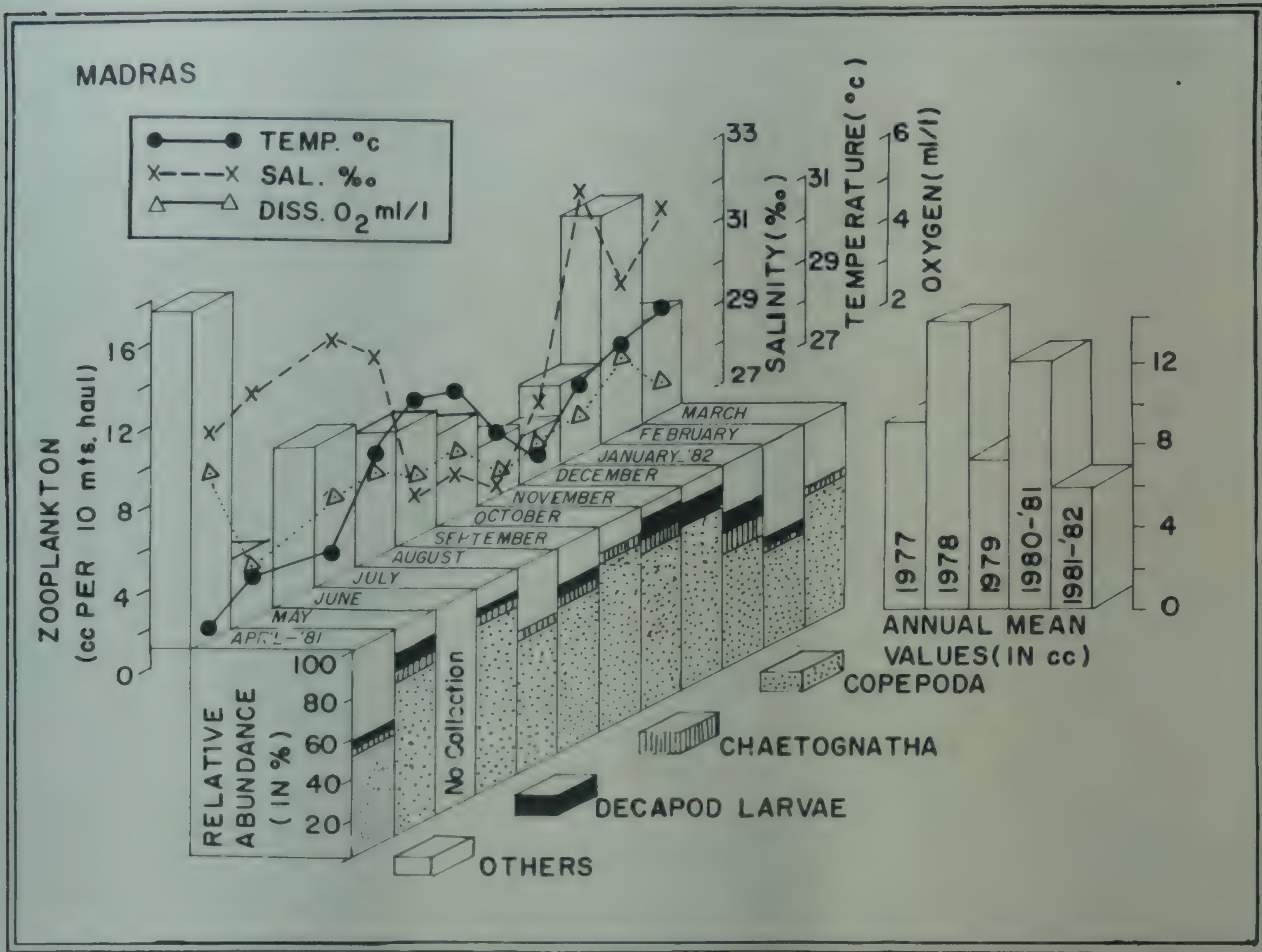


Fig. 7. Trends in secondary production at Madras.

period. In Tuticorin on the other hand the lowest rate of production was observed in 1977–78 from which it gradually improved until 1980–81 only to reduce a little in 1981–82. For the Bombay waters the available data on the annual mean production showed 1979–80 period to be the year of least production. In the ensuring year the quantum of production showed more than a two fold increase which was almost maintaine during the 1980-81 period. However, collections wer not made during the southwest monsoon months o 1981–82. In Calicut also the zooplankton productio rate remained more or less steady during the 1977–8 period with a sudden increase in 1980. During the year period the 1981 – 82 figure was the lowest.

KURUMA SHRIMP FROM BOMBAY WATERS — A NEW RESOURCE*

The prawn fishery of Maharashtra State has shown great strides in recent years and with the increasing introduction of mechanised trawlers of different sizes and their operations beyond the conventional zones exploited by the traditional fishery, more and more species growing to different sizes are appearing in the fishery. Thus from 1977 onwards one species of prawn belonging to the genus *Penaeus* has been increasingly represented in the catches of the trawl fishery of Bombay and landed at Sassoon Dock. Although not contributing to a very large fishery the species has been found in the catches sporadically in small quantities, amounting to nearly 10 to 15 tonnes annually. In view of the larger sizes of this prawn and the attractive colour bands resembling the Japanese prawn, there is great demand for the species from the processors exporting frozen shrimps especially to Japan. The species was later identified as *Penaeus japonicus* which is the favourite 'Kuruma shrimp' of Japanese waters. Since the occurrence of this prawn in fairly good quantities has come as a new resource not reported earlier, a close study of its fishery and biological aspects was undertaken based on the landings at Sassoon Dock and the results are reported in this contribution.

Fig 1. Kuruma Shrimp, *Penaeus japonicus*.

Systematics

Detailed examinations of the specimens collected from the catches showed that the species is *Penaeus japonicus* Bate. Considerable confusion exists regarding the identity of this species in Indian waters. The species is very closely allied to *P.canaliculatus* which was recently reported occurring in the fishery as a new resource in Quilon area in the Kerala coast *(Mar. Fish. Infor. Serv. T & E Ser.*, 35: 15–17, 1982). There are reports of *P.canaliculatus* as well as *P.japonicus* in stray numbers from other parts of Indian coast. Both species show very similar morphological features in the number of rostral teeth, extension of the adrostral sulcus or the groove on the dorsal aspect of the carapace to the posterior end of the carapace and the colour pattern. However, a closer examination would show that the two species are quite different. The most important diagnostic features which distinguish these species are: 1) while 3 pairs of spinules are present on the lateral sides of the telson in *P.japonicus* the spinules are absent in the telson of *P.canaliculatus, and* 2) the seminal receptacle in the thelycum is divided in *P.canaliculatus* while it is cylindrical in *P.japonicus*. With the help of these clearcut differences it has been possible to identify the species presently occurring in the fishery in Bombay as undoubtedly *P.japonicus*. It is quite possible that the record of *P.canaliculatus* from Bombay waters by Kunju (*Mar. Biol. Ass. India, Proc. Symp. Crust.IV*: 1382–97; 1967) may probably be *P.japonicus*.

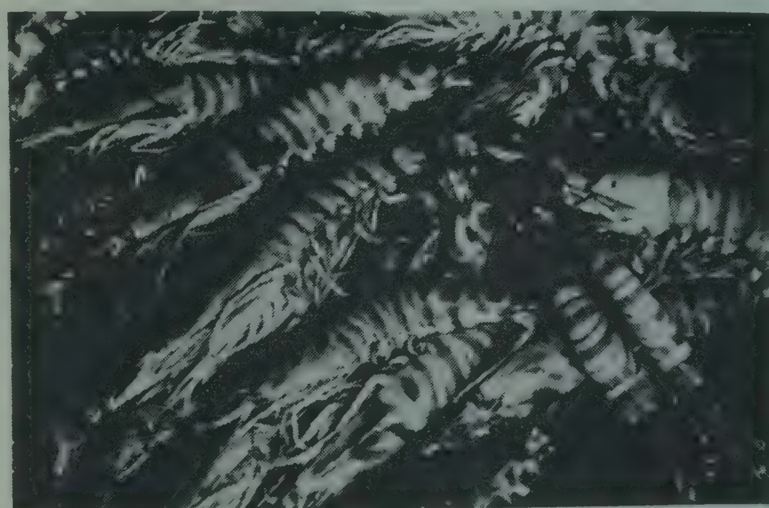


Fig 2. A collection of *Penaeus japonicus* landed at Sassoon Dock, Bombay in June 1982.

The popular name given for the species by FAO is "Kuruma prawn" (L.B.Holthuis, FAO species Catalogue, *FAO Fish. Synop.* (125) Vol. 1: p.46, 1980). It is known under different popular names in different countries eg. Ginger prawn in South Africa, Flowery prawn in Hong Kong and India, Banded shrimp in Taiwan, Kuruma ebi in Japan, Oriental brown shrimp in Korea, Japanese king prawn in Australia and Kuruma shrimp in U.S.A. Recently some firms in Japan have imported the frozen prawns of the species under the trade name of bamboo prawn. The species has a wide distribution in Indo–west Pacific and in some parts of

*Prepared by M.Aravindakshan and J.P.Karbhari.

Eastern Atlantic. It is of major commercial importance in Japan, being the most valuable of the commercial shrimps there, both in trawl fishery as well as pond fishery.

Fishery in Bombay

P.japonicus was caught along with other penaeid prawns by the mechanised vessels using 18 and 22 m otter trawls operated at depths ranging from 40 to 60 m off Bombay coast. Small quantities have been noticed in the dol net catches also. The landings of the species at Sassoon Dock indicate that the fishery is highly fluctuating and also sporadic to a certain extent. The species was first noticed to have some magnitude of a fishery in 1977. The annual catch figures increased in subsequent years and in 1979 a catch of 15 tonnes was registered (Fig.1). Thereafter a decline was seen in the following years and in 1982 the catches registered 16.7 tonnes. The average landings at this centre amounted to 7.6 tonnes a year. The percentage of this species at this landing centre works out to about 1 in the total prawn landed. It is landed in very small quantities at New Ferry Wharf, Dabhol, Ratnagiri and some other centres also. The annual catch per unit at Sassoon Dock showed a maximum of 15.1 kg per unit in 1978 and minimum of 7.4 kg per unit in 1979.

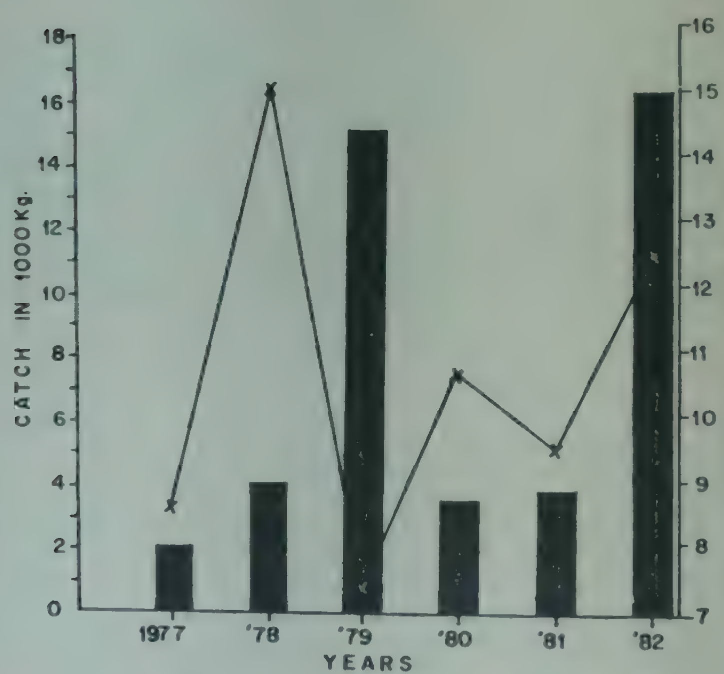


Fig. 1. Total catch and catch per unit of *Penaeus japonicus* at Sassoon Dock during 1977-1982.

The monthly trend of catches during 1977-1982 is presented in Table.1. In all the years the maximum landings are noted in June to September period except in 1979 when it continued in October, November months also. During the other months the fishery is at a low level, probably due to the fact that the trawlers operate in slightly deeper zones where the species is available in abundance during the May - August period and in shallower zones during October -December period. The catch per unit also shows the maximum in June to August period and the minimum in October to March period as in the case of total catch. The catch rate gave a maximum of 33.3 kg per unit in June 1979.

Size distribution

The sizes of these prawns represented in the catches ranged from 110 mm to 225 mm, the females as usual showing larger sizes. The largest male specimen noted measured 190 mm in total length and that of female specimen 225 mm. The annual picture of the length frequency distribution of the species in the fishery during the years, 1977-82 is depicted in Fig.2. In 1977 the dominant size groups were in the larger size range of 148-163 mm. In the next three years the major modal sizes went down to the size ranges of 118 -133 mm. In 1981, although the smaller sizes were dominant the larger size ranges of 148-163 were equally dominant, especially the females. In 1982 the smaller sizes were not noticed in the catches, large sized females being present in good quantities.

Food of the species

In order to get an idea about the food of this species the stomach contents of 240 specimens were examined. Based on this study, on an average 40% of the stomach contents were crustacean remains, 20% polycheate remains, 25% molluscan remains and the rest 15% sand grains and debris. The crustacean remains consisted mainly of decapods. The study reveals that *P.japonicus* is carnivorous in food habits and also bottom feeding. Similar results were obtained for the species from a study in Malaysian waters by Hall (*Fish. Publ. Colonial Off,* 17: 1-229. 1962).

Sex ratio

Females were noticed to be predominat in the catches during all the years, with the sex ratio of females to males 3:1. However, during June-July months when the catches were higher the ratio of females to males was 2:1. Males did not dominate in the catches at any time of the study.

Maturity and spawning

Mature male and female specimens were noticed in the catches in most of the months. However, gravid females were represented in maximum quantities in the months July, August and September, their percentage representation reaching from 60 to 80 in

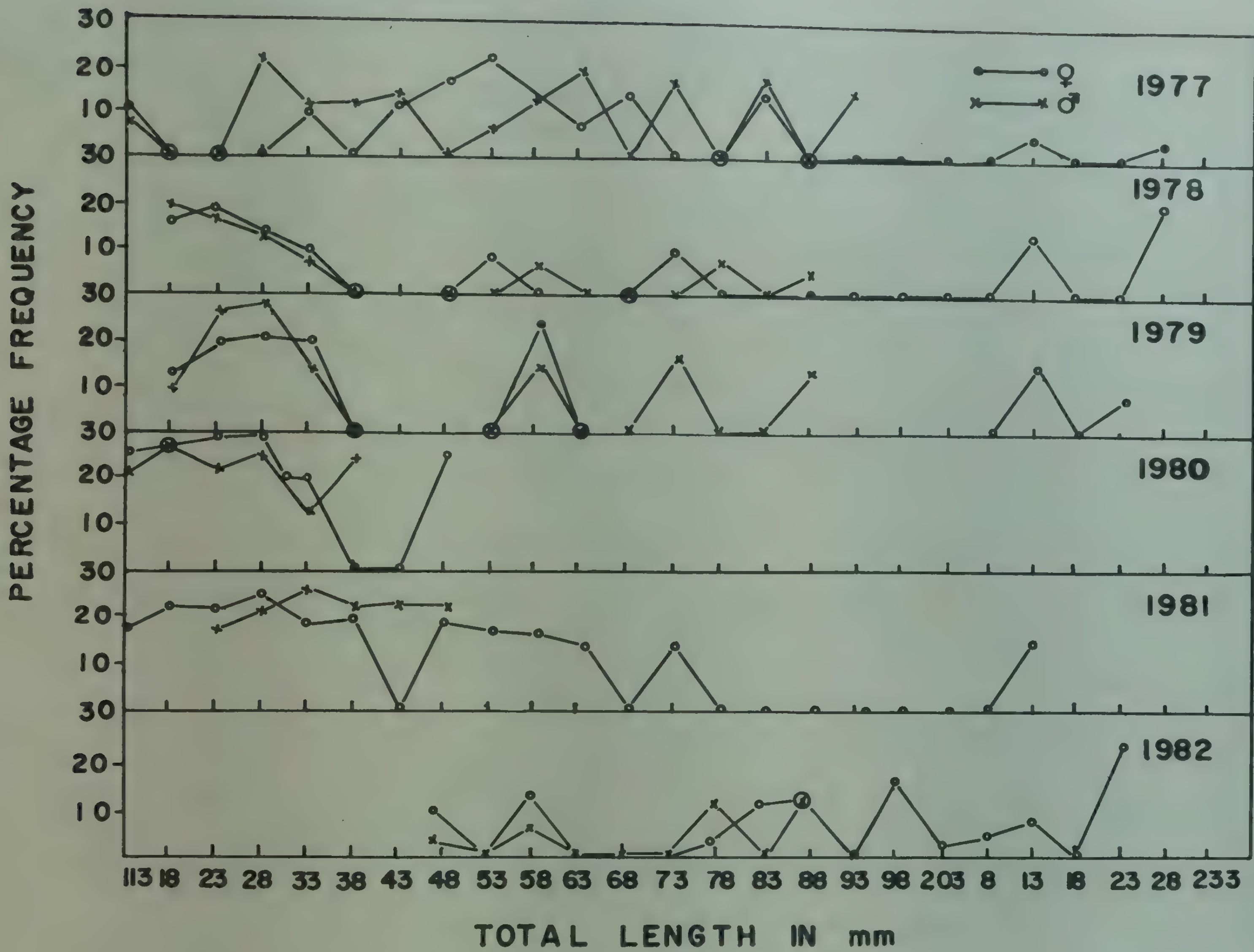


Fig. 2. Length frequency distribution of *Penaeus japonicus* at Sassoon Dock in 1977-1982

Table. 1. Catches of *Penaeus japonicus* at Sassoon Dock during 1977-82

Years	Months (catch in kg with catch per unit in paranthesis)												Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1977	80 (4)	90 (5.5)	70 (7)	65 (5)	60 (4)	200 (20)	600 (20)	650 (25)	50 (5)	60 (4)	50 (2)	25 (2)	2,000 (8.6)
1978	120 (3)	140 (7)	320 (10)	440 (11)	250 (10)	600 (20)	800 (20)	750 (25)	660 (30)	—	—	—	4,080 (15.1)
1979	60 (3)	52 (3)	48 (2)	502 (12)	450 (1.5)	2,000 (33.3)	— —	3,150 (20)	2,480 (1.5)	2,500 (1.4)	3,200 (1.7)	600 (1.5)	15,042 (7.4)
1980	100 (4)	124 (10)	138 (5)	142 (15)	600 (20)	400 (10)	600 (25)	1,400 (30)	80 (2)	60 (2)	120 (3)	80 (2)	3,844 (10.7)
1981	121 (3.5)	200 (5)	128 (10.2)	132 (15)	500 (22)	600 (10)	825 (25)	1,200 (15)	70 (2.5)	90 (2)	130 (2)	90 (1.5)	4,086 (9.5)
1982	95 (3.5)	180 (9)	115 (7.1)	135 (9)	240 (20)	170 (17)	6,506 (26)	6,000 (20)	3,018 (10.1)	80 (8)	90 (6)	115 (6.5)	16,744 (11.9)

these months. From this it appears that the peak spawning period in the offshore regions is in these months. The sizes of mature females, in general, ranged between 150 and 225 mm.

Exports

Upto 1980 *P.japonicus* was exported from Bombay, mostly to Japan, under the commercial packings known as "tiger" and "flower" which included species like *P.monodon*, *P.semisulcatus*, *P.penicillatus* and *P.japonicus*. M/s Castle Rock Fisheries and Castle Rock Sea foods (P) Ltd., Bombay and Tata Fisheries (P) Ltd were the chief exporters. Later Japan showed interest in importing *P.japonicus* their favourite species, packed exclusively. Therefore, these exporters located in Bombay packed this species, head on, and exported under the trade name "bamboo prawn" in 1981 and 1982, fetching higher unit value of upto 15 U.S. dollars per kg. Yearly 9 to 20 tonnes of export of the species has been made by these firms.

General Remarks

Penaeus japonicus is one of the penaeid prawns growing to fairly large sizes which are very much in demand from the industry. Being a species occurring in great abundance in Japanese waters and greatly sought after by the shrimp industry there, the species would be of great interest in the export market, especially to Japan. Therefore, the appearance of this species, hitherto not reported to contribute to any significant fishery anywhere along the coast of India, in the magnitude of a fishery in Bombay waters is very interesting. This prawn fetches premium prices in the Bombay market, 1 kg of the species costing Rs.80 to 100 even in the local auction sales at the landing centre, indicating the demand for export purposes. Now that the species has appeared in appreciable quantities in the trawl fishery in Bombay, it is likely that it is available in other areas along the coasts of India. Hence a proper assessment of the resources of this species in Indian waters would be useful.

Among the species of prawns cultured in the different parts of the world *P.japonicus* has an important place, being the first species of penaeid prawn subjected to laboratory spawning and pond culture. In Japan the complete early larval history of the species was worked out as early as 1942 and from that time onwards large scale commercial culture of the species is practiced in that country, in addition to the natural harvest from the sea. In the present fishery of the species from Bombay the presence of fully mature males and females indicates that aquaculture of this prawn could be developed to a very great advantage by collecting spawners, inducing them to spawn in controlled environment and adopting proper hatchery and rearing techniques. This would go a long way in satisfying the demand from the export industry for species growing to larger sizes and thus add to the foreign exchange earning of the country.

The authors are thankful to Dr.E.G. Silas, Director of CMFRI for his interest and encouragement and to Dr.M.J. George, Scientist S3 for guidance.

FARMING THE COASTAL LAND AT TUTICORIN*

Introduction

The need for the utilisation of derelict area for commercial culture of fishes and prawns has been stressed much in recent time as there is vast scope for the development of such high brine water along the southeast coast of India. A number of private farmers have put in efforts to develop culture practices along the ocastal villages of this zone. Among the various priority areas for research and development, the Tuticorin Research Centre of Central Marine Fisheries Research Institute devoted its attention in developing systems for the culture of fin fishes, prawns and crabs by establishing seed resources, identifying suitable water spreads and developing techniques of farming. 6.07 hectare (15 acre)of intertidal swampy flat on the edge of Tuticorin Bay, adjacent to the oyster farm and field laboratory in harbour link road have been converted into productive fish farm. This low land belongs to the Port Trust of Tuticorin and was acquired on terms of lease for 30 years. The outskirts of the site reveal all possibilities for quick development of mariculture practices. The present report describes the environmental features of the culture ground, the construction of coastal ponds, the results and problems and envisages the scope for further development of extensive, unutilized areas into productive farms.

Resources

The existence of seeds of considerable varieties of euryhaline, culturable species in the tidal inlets along the coast of Gulf of Mannar, that too, in different seasons of the year facilitated the start of fish farming experiments at Tuticorin. The seeds of milkfish occur in adequate quantities in the backwaters of Valinokkam, Punnakayal and Tiruchendur during April–May. The grounds and season for the collection of fingerlings of mullets like *Mugil cephalus* and *Liza macrolepis* have been identified. The tidal pools adjoining the creeks of Alangarathittu, Pullavali and Palayakayal are the resourceful beds for the mullet seeds. The seeds of the prawn *Penaeus inducus* are rich in coastal lagoons and estuarine belts and could be collected in 3 different seasons of the year. The young ones of the crab *Scylla serrata* are available in the tidal flats and mangrove swamp areas in Tuticorin, Pullavali and Sahurpuram and the best period for the maximum collection is July–September. All these species possess high reproductive capacity, short larval development, fast rate of growth, unique physiological features to adjust to wide environmental changes and fetch a good market price.

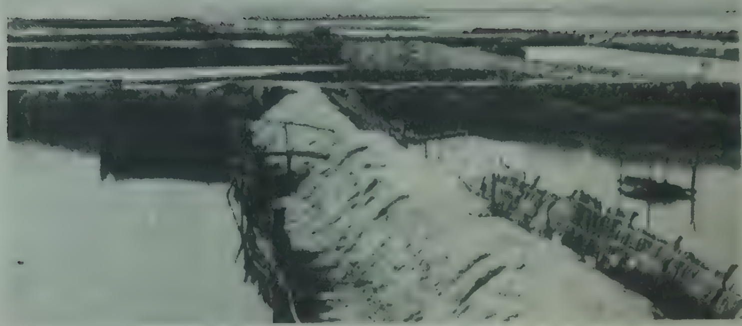
The water characteristics of the culture site are suitable for continuing the experiments, although the monthly average values of surface temperature, dissolved oxygen content and salinity of the ponds are always higher than that of the open sea. The temperature of the pond water varied from 27 to 31.5°C with the maximum noticed in hot sesons of May and October. The dissolved oxygen content is measured in the range 3.5–6.0 ml/L and fluctuates widely in rainy season . The salinity of the culture site varies from 17 to 50 ppm. The maximum is reached due to the poor tidal amplitude and the low exchange of water, particularly in the months May–September. The site does not face any drastic changes in the environment as there is no river or creek nearby.

Site development

The elevation of the site in relation to the tidal amplitude is the advantageous factor for the selection of culture bed in the protected bay. The area is very flat and exposed during low tide. The mangrove swamps are reclaimed by cutting down the plants *Avicinia* and raising the bunds with the mud excavated from the pond area as the soil has good water retention properties (Fig.1). The floor of the pond is levelled after the mangrove roots are pulled out and stumps eliminated. The ponds are filled and flushed on the tides, even though the tidal range is quite modest here. The area enjoys a diurnal tide with a range upto 120 cm at spring tide and 30 cm or even less during neap tides. The ponds are made in such a

Fig. 1. Construction of ponds in swampy land.

*Prepared by R.Marichamy and S.Rajapackiam.



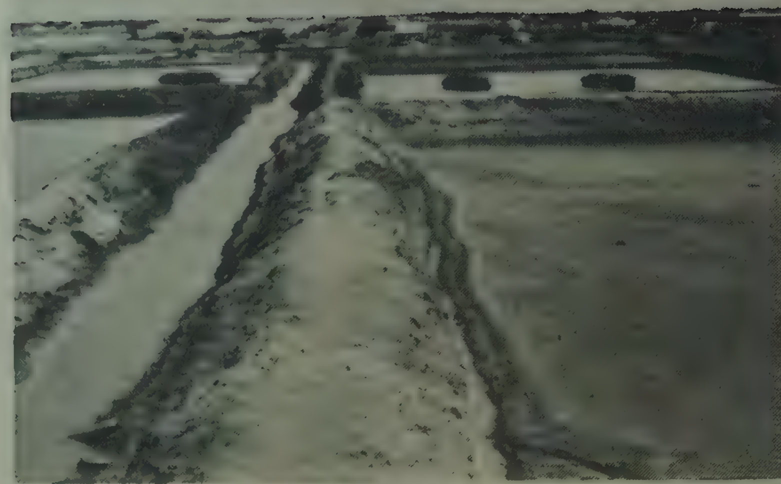


Fig. 2-3. Views of coastal ponds.

Fig. 4. Preparation of chanos pond by baking.

Fig. 5. Harvested fishes from ponds.

way that their bottom attains a level of 30 cm beneath the mean high-water spring. The sluice pipes are fixed on two sides of the pond at different levels so as to serve as inlets and outlets. The pond bottom slopes gently towards the outlet sluice and traversed by shallow radiating ditches orginating from the harvest basin or catching pit. Maximum exchange of water is possible during spring tide days around fullmoon and newmoon. The bottom consists of soft mud. This hydrophylic mud is biologically active and contains sufficient percentage of humus and large amounts of clay. Such soils provide an excellent environment for the development of algae along with the associated micro-organisms which form the main food of cultivable organisms.

The lay-out of ponds are planned according to the local topographical conditions. 14 ponds, each in the size of quarter hectare with a depth of 1.5 m are constructed. Two main feeder canals with a width of 2 m orginating from the bay on southern side of the site, one in the middle of the farm and the other along the road side, encircle the ponds (Fig.2-3). Radiating canals are arranged at an interval of two ponds. The ponds are provided with cement sluice pipes of 6″ diameter which made control of the water level possible. 6-8 pipes are fitted on two side bunds of the pond and most of the ponds are connected with supply channel atleast on two sides. Velon screens tied at both ends of the sluice pipes serve as sieves. The entire farm is protected from open sea by strong embankment which stand one metre above the highest tide level. It is sufficiently broad to withstand the dynamic force of the tides and pressure. The bunds are constructed in stages by laying the excavated mud slabs, free from roots and twigs, in layers which are compacted and allowed to dry in the sun before adding the next layer. Fencing arrangements with special design are made to crab culture ponds. Mounts with mangrove vegetation are retained in these ponds so as to provide ample natural ecosystem.

Milkfish ponds need special preparation immediately after harvesting. The ponds are drained and exposed to air and sun for sufficiently long time to

make the soil surface cracked (Fig.4). Such baking procedure is deemed of paramount importance, since it destroys a variety of unwanted organisms and boosts up the mineralisation process in the top sediment layers and improve the fertility of the pond. Drying out is effective because of the provisions of a good net work of drainage ditches. Ponds which are never dried out gradually lose their value and their exploitation finally ceases to be profitable. This process is also necessary to carry out the essential repair works in ponds.

Culture practices

Experiments on the culture of the mullet *L.macrolepis* and the milk fish *Chanos chanos* were carried out in these ponds during the last three years. *P.indicus* and *S.serrata* were also reared separately in four ponds. The period of culture is normally 10 months and designed from May–February. The rest of the period is devoted towards maintenance and preparation works. The composite culture with compatible species like milkfish and mullet was found to give promising results. Monoculture practices done exclusively with milkfish or mullet in rest of the ponds with different stocking intensities have thrown light in determining the optimum stocking level for better yield. Rice bran and ground nut oil cake at the ratio of 2:1 were supplied to the stocks at 5% of the body weight. The predatory fishes like *Lates calcarifer*, *Terappon* spp., Elops sp., *Polynemus* sp., *Ophiocephalus* sp., *Arius* spp., were eradicated from the ponds periodically by employing the gill net and cast net. The results of the culture experiments were encouraging (Fig.5). Different sets of experiments were completed and the following are the salient features emerging from these preliminary experiments.

1. The growth of milkfish and mullet is slow during the beginning days of stocking due to the prevalence of high salinity in ponds in May–June. The growth is accelerated when a fall in salinity is noticed from July onwards and this is well noticed in milkfish.

2. A maximum overall growth of 30 mm/month and 24 mm/month is observed in *C.chanos* and *L.macrolepis* respectively when stocked at the optimum level of 1 seed/m^2.

3. The milkfish seed released at 28 mm have grown to 335 mm/226 g in a period of 10 months.

4. Better survival and production is noticed with *L.macrolepis*.

5. Poor growth resulted from overstocking besides the other causes like poor depth of water, increased temperature and increase in salinity.

6. The total production encountered in a polyculture experiment is 1644 kg/ha/yr.

7. Harvesting is comparatively easy when single size stocking is practiced.

Development prospects

The facilities for culturing prawns and fishes in coastal lands have been developed using very simple techniques. Farm engineering for marine aquaculture is comparatively a new field and innovative techniques to suit the local conditions need further improvements. Based on the preliminary experiments, several development efforts appear to be warranted for achievement of success. Adequate number of sluices in different dimensions are to be provided for a better exchange of water inside the ponds so that the depth and salinity can be maintained at required levels to promote growth. The shallow outskirts of the culture site are the common fishing ground and to avoid the threat of poaching, fencing arrangements around the fish farm as well as a constant watch and ward set up are the priority requirements for the success of the culture project. Effective system to control the entry of predatory fishes inside the ponds is to be evolved besides the efforts of eradication.

The prevalence of poor tidal amplitude in this region during June–August affects the culture results to a great extent and to solve this problem deepening of the feeder canal and some of the ponds are suggested. This may pose the problem of draining and harvesting. An alternate planning is the careful adjustment of the culture period whereby the adverse period can be avoided or prefixed.

Concerted efforts to tackle some of these problems would hasten the establishment of fish farms on the edge of the sea in these areas, greatly aiding the augmentation of fish production. The present experiments have indicated the possibility of large scale development of farming in the coastal flats.

OCCURRENCE OF WAHOO, ORIENTAL BONITO AND BIGEYE TUNA OFF KARWAR*

With the advent of purse seines in Karnataka, besides the traditional catches of oil sardine and mackerel, of late, other resources are coming to light in the coastal waters of this state.

On 1st October 1982, a purse seine landed a few numbers of seer fishes and amongst them was a lone Wahoo, *Acanthocybium solandri*. It measured 1 m in total length and weighed 5 kg. This is the first time that the occurrence of this species has been noticed in the inshore waters of the west coast other than at Vizhinjam and Colachel situated at the extreme southwest coast of India. This indicates a northern extension of the distribution of Wahoo along the west coast.

Purse seines landed considerable quantities of little tunny, *Euthynnus affinis* also on 8th October 1982 at Karwar. A closer examination of the catches resulted in the detection of three numbers of Oriental bonito, *Sarda orientalis*. They measured 272 mm, 280 mm and 292 mm in total length, weighing 225 g, 261 g and 332 g respectively, and all of them with sexes indeterminate.

A few numbers of bigeye tuna, *Thunnus obesus* were landed by driftnet units on 19th October at Karwar. Their total length and weight ranged from 375 mm to 425 mm and from 629 g to 833 g respectively.

The occurrence of *Sarda orientalis* from the coastal area of the west coast was also reported earlier from Vizhinjam and that of *T. obesus* from Kavarathi and Lakshadweep seas. The present observations tend to show that they have extended distribution in the coastal waters of the west coast and chances of these species coming into commercial exploitation cannot be ruled out.

Incidentally, *Acanthocybium solandri* and *Sarda orientalis* have also been reported from the area between 15° and 24° N. (55–360 m zone) during the exploratory surveys of M.T. *Murena* (*Bapat et al., Bull. Cent. mar. Fish. Res. Inst. 33, 1982*).

a

Fig.1. a) *Acanthocybium solandri*, b) *Sarda orientalis* c) *Thunnus obesus*

*Prepared by M.H.Dulkhed, G.G.Annigeri and G.M.Kulkarni.

PROVEN TECHNOLOGY

4. HATCHERY TECHNOLOGY FOR MASS PRODUCTION OF MARINE PRAWN SEEDS*

Highlights: Technology of rearing larval forms of marine prawns to stockable seed size has developed chiefly through Japanese efforts in recent years. Due to varying climatic conditions and occurrence of different candidate species in other parts of the world this technology could not be adopted *in toto* in other countries. It required adaptation to the local conditions. Due to the high priority given to development of prawn culture in our country it has become an imperative need to adapt this technology to our conditions. The Japanese technology relied on use of culture of the diatom *Skeletonema costatum* and the freshly hatched larvae of the brine shrimp *Artemia salina* for feeding the various larval stages. Although the species of diatom is available in the country, maintenance of cultures is rendered difficult due to the prevailing temperature regime. The brine shrimp eggs are too expensive. The method developed at the CMFRI obviates the use of both these organisms and instead relies on cultures of a locally available diatom, *Chaetoceros affinis* and a euryhaline strain of rotifer *Brachionus plicatilis*. Survival rate of 70% has been obtained by use of these organisms as larval feed.

Operational Details: The penaeid egg hatches out into a nauplius which passes through protozoea and mysis stages before it becomes a postlarva. The freshly hatched nauplii are stocked in 2 ton capacity plastic tanks containing settled and filtered seawater of salinity 30–32 ppt, at the rate of 50 larvae per litre. Vigorous aeration is provided from an oil free air compressor or blower throughout the rearing period. In the normal ambient temperature of 28°C the nauplius passes through 6 substages and transforms into protozoea after 2 days. In the last nauplius stage, separately cultured diatom, *Chaetoceros* (200,000 cells) per ml) is added at the rate of 200 litres per tank. This is done after reducing the water level of the tank to the extent of 200 litres. From protozoea I onwards the larvae begin to feed on the diatoms. The feeding operation is repeated every day. After a period of 3 – 4 days the protozoea, having passed through 3 substages, transforms into the mysis stage. At this stage in addition to the diatom culture, frozen rotifer *Brachionus plicatilis* (separately cultured, harvested and frozen into blocks) is also provided as food at the rate of 100 rotifers per larva per day. The mysis passes through 3 substages in as many days and metamorphoses into the first postlarva. At this stage the feeding of diatom is discontinued and frozen cladoceran, *Moina* sp. (separately cultured, harvested and frozen into blocks) is given as food at the rate of 20 per postlarva per day. Five days after they became postlarva they are harvested and counted before stocking in nursery or packing and despatching to the farmers who have nurseries.

From nauplius to postlarva an average survival rate of 70% is achieved although on several occasions survival rates as high as 95% have been recorded.

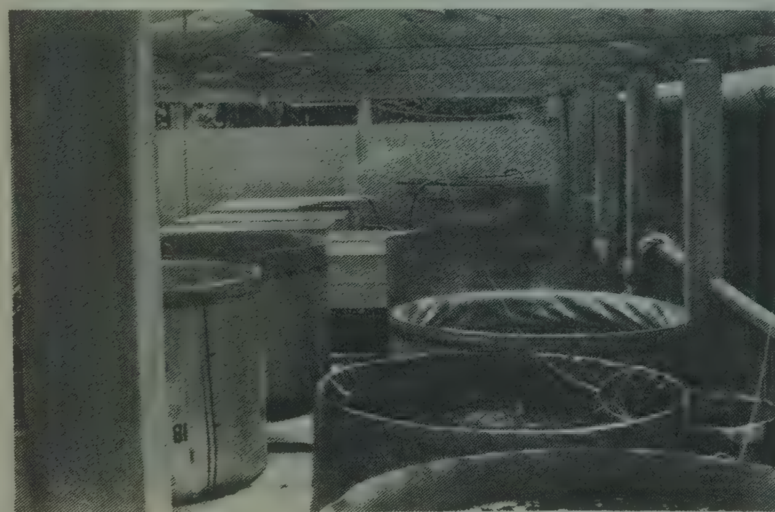


Fig 1. Live feed cultures at NPCL

Production: The magnitude of production depends on the facilities available. With the existing facilities available at the Narakkal Prawn Culture Laboratory (NPCL) of CMFRI, (6 rearing tanks of 2 ton capacity, 6 fibreglass tanks of 1 ton capacity for phytoplankton cultures, 1 rotifer tank of 40 ton capacity and 4 Moina tanks of 2.5 ton capacity) it is possible to rear 6,00,000 larvae per operation lasting 15 days i.e.1.2 million larvae per month. At the average rate of 70% survival 8,40,000 postlarvae can be produced per month. If 20 numbers of 10 ton capacity tanks are used for rearing and the other facilities are increased proportionately it should be possible to develop a system to produce 14 million prawn seeds per month.

Inventory and cost: It is to be clearly understood that the larval rearing technology is the most important aspect of prawn seed production but a unit of such production can function only along with other technological link-ups such as know-how for spawning prawns under controlled conditions, culturing and maintaining live feed for the larvae and mainte-

Fig 2. Larval rearing pools at NPCL of CMFRI.

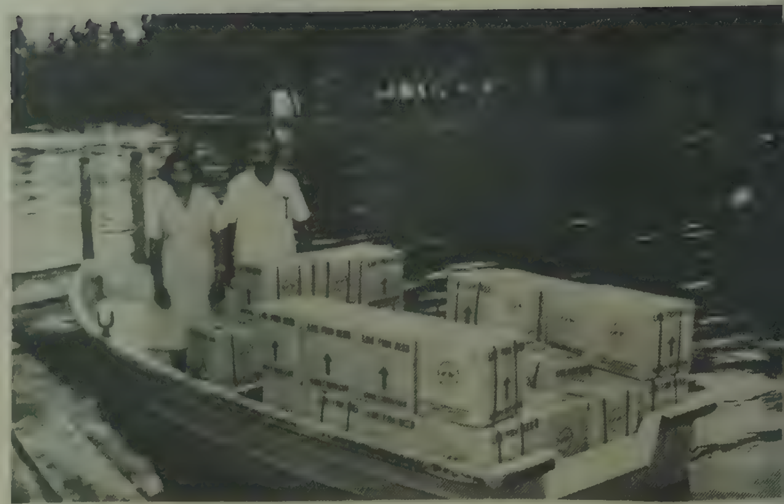


Fig 3. A farmer taking consignment of prawn seeds.

nance of live prawn seeds for distribution. While considering a project for commercial production of prawn seeds all the above factors should be considered in an integrated pattern to work out the capital costs. For a unit aiming at a production of 14.0 million seeds per month for a period of 5 years the cost of chief equipments such as Pumps, Air compressors, Generators, Pools/tanks, refrigerator, deep freezer, Dinghies, Out-board motors, vehicles and lab equipments would be round Rs.1.5 million; land and buildings about Rs.1.0 million and contingencies including salaries, labour and maintenance expenditure about Rs.2.5 million (0.5 × 5) totalling Rs.5.0 million for 5 years.

It is difficult to work out the production cost based on the laboratory and small scale operations but on the basis of our experience the production cost of 1,000 seeds cannot exceed Rs.6.00.

Prospects: In the light of the present trend of development of prawn culture there is considerable scope for establishing hatcheries in the coastal districts of all maritime states of the country for distribution of prawn seeds to the farmers. There is also scope for development of export trade on live prawn seeds.*

*Prepared by scientists of NPCL.

NEWS-INDIA AND OVERSEAS

New publication in Fishery Science

Tamil Nadu Agriculture University, Fisheries College at Tuticorin, Tamil Nadu, India is bringing out a new publication entitled Journal of Fishery Science. The first issue of the journal is scheduled to be published in January 1983. Annual subscription membership and research papers for publication are invited by the Chief Editor, Journal of Fishery Science, Fisheries College, Tuticorin 628 003. For further particulars kindly contact the Chief Editor.

Devil ray landed in Pondicherry

A huge devil ray was caught in a mechanised gill net operated at 40 m depth off Pudukkuppam, a fishing village in Pondicherry Union Territory, on 21st September 1982. The devil ray locally known as "Kambuthirukkai" was identified as *Manta birostris* with the following measurements:

Devil Ray.

Total length	3.29 m
Length of tail	0.80 m
Breadth	4.26 m
Length of cephalic horns	0.35 m
Distance between cephlic horns	0.70 m
Width of mouth	0.70 m

It weighed approximately 500 kg and the colour was darkish brown dorsally and whitish ventrally.

Reported by E. Palani and L. Chidambaram

Genetic blue lobsters produced

In a pilot aquaculture programme at Montauk, New York the first generations of exotic blue lobsters, representing a giant step in the development of a unique strain of the American lobster *Homarus americanus* have been produced. These animals are naturally brownish in colour. It is estimated that genetically blue lobsters occur in the wild at the rate of one in every 30 million. The brood of juveniles artificially produced from these extremely rare mutants match exactly the deep rich cobalt and pastel blue colouration of their parents.

The new tribe of aristocratic lobsters have resulted from seven years of trial and error research by Dr.Anthony D' Agostino, marine biologist in New York Ocean Science Laboratory. He has finally succeeded in demonstrating in his laboratory for the first time that blue lobsters can be bred with the filial generation faithfully inheriting the shell colour of the parents. He plans to designate the strains derived from the inbreeding of these blue lobsters as *Homarus americanus* var. DAG with the common name of "Montauk Genetic Blue Lobsters".

Aquaculture 8 (3) : 1982.

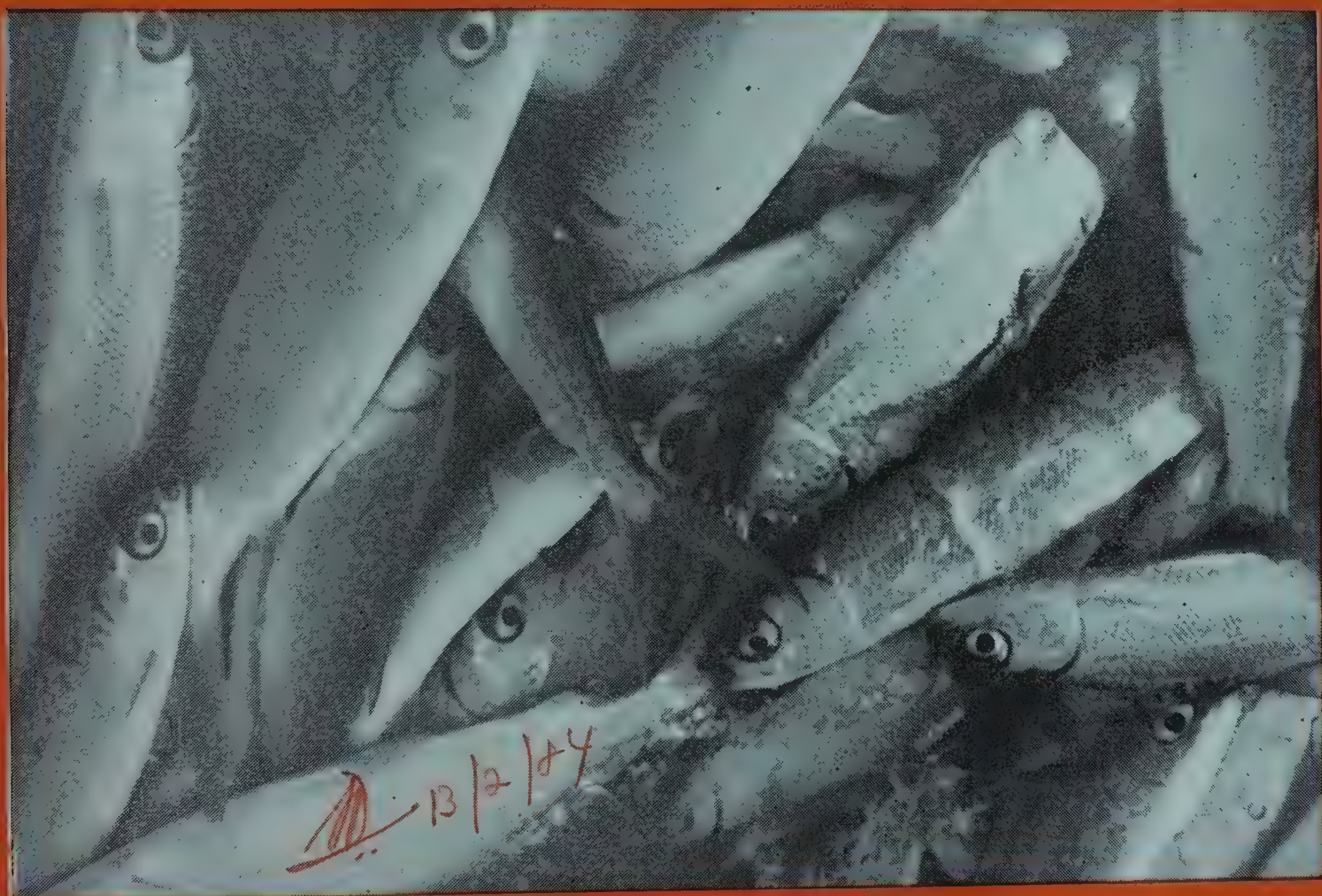
Energy from the Ocean

At a competition organised by the National Centre for Exploitation of Oceans (CNEXO) and the National Agency for Development of Research (ANVAR) in France, a project for the utilisation of ocean wave energy has been selected for further development. After preliminary trials small power stations of a few megawatts capacity will be developed. The design incorporates a platform with an inclined plane on which the waves break. The water rising above the surface level in this manner drives a turbine while returning to the sea.

GEDUST Bulletin, November 1982.

Compiled and prepared by M.J. George, G. Subbaraju and S.K. Dharmaraja.
Published by Dr. M.J. George, Senior Scientist on behalf of the Director, Central Marine Fisheries Research Institute, Cochin-682 018. Phototypeset and printed at PAICO, Cochin 31.

MARINE FISHERIES INFORMATION SERVICE



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No. 48

MARCH, 1983

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Abbreviation— *Mar. Fish. Infor. Serv. T & E Ser.*, No. 48: 1983..

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Cover Photo: Milk fish harvested from the pond at Mandapam

FISH CULTURE IN MARINE FARM AT MANDAPAM

G. Mohanraj, A. Raju, V. Gandhi and V.S. Rengaswamy

Introduction

It is well known that large-scale monoculture and polyculture of the milkfish, *Chanos chanos* (Forskal) (Fig.1) are undertaken both in brackishwater and seawater farms in many Southeast Asian countries, particularly in Indonesia, Philippines and Taiwan. In polyculture, milkfish is cultured either with another fin fish (mullet) or with the shellfish (prawn and crab). Milkfish culture in India was initiated by the Madras Fisheries Department. Culture experiments conducted by Tampi *(Ind. J.Fish.*7 (1): 137–46, 1960) at Mandapam indicated the potentiality of milkfish culture even in an apparently low productive coastal pond of Mandapam area with a moderate biological niche. Further confirmatory culture experiments in this region were hampered because of the total devastation of the farm by the cyclone in 1964. After renovation and remodelling of the ponds at Mandapam, monoculture and polyculture experiments on milkfish were possible only during 1980–82. The present report highlights some interesting and encouraging results obtained during the experiments conducted in 1981–82 and provides further useful information to the culturist on the feasibility of undertaking marine fish culture along the coastal areas of Ramanathapuram District.

Monoculture of milkfish

Pond preparation

The culture experiment was planned in a 0.25 ha pond. Earlier, the water in the pond was completely drained eradicating undesirable fishes and other competitor organisms. It was allowed to dry for a few days before pumping seawater to a depth of 45 cm. This depth was maintained throughout the period of experiment by resorting to daily pumping of seawater.

Stocking

1000 milkfish fingerlings, collected from tidal pools at Pamban and Pillaimadam lagoon were stocked in September 1981 at a stocking rate of 4000/ha. The average length and weight of fingerlings at the time of stocking were 129 mm and 13 g respectively. Supplementary feeding with doughs of rice bran, groundnut oil cake, tapioca powder and fishmeal mixed in equal proportion was done at the rate of 5–10% of body weight. Fish samples were taken once in 30 days from the pond and the length and weight of about 10% of the total stock in the pond were recorded to ascertain the growth rate. Environmental parameters were periodically recorded (Fig.2) for the ten month duration of the experiment.

Fig. 1. The milkfish, *Chanos chanos* (Forskal).

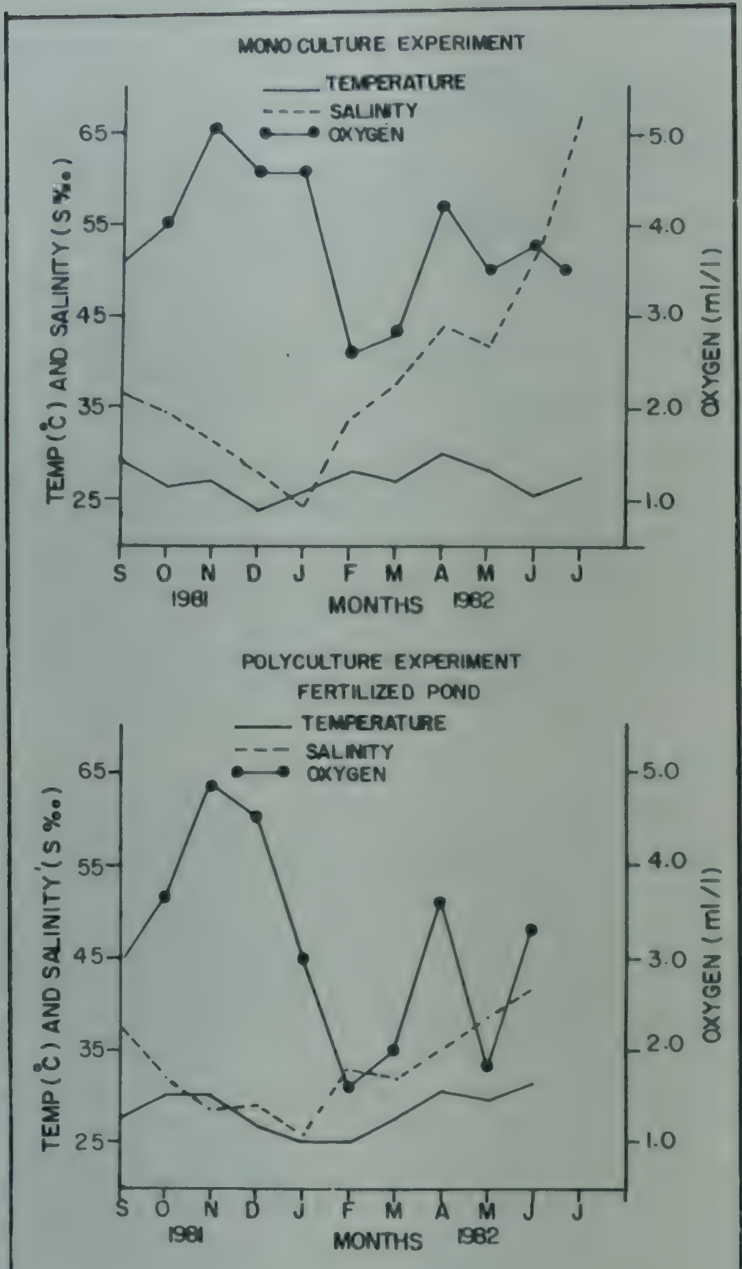


Fig. 2. The environmental parameters of the pond water showing the monthly average of temperature, salinity and oxygen in the monoculture and polyculture of milkfish.

Results

i) Growth

The average length and weight of milkfish recorded in different months are given in Fig.3. The average size of the fish increased from 129 mm (13 g) in September '81 to 250 mm (133.9 g) in three months, 293.7 mm (195.3 g) in six months and 368.7 mm (325.4 g) at harvest (at the end of ten months). The monthly increment in length varied between 1.58 mm and 72.35 mm and the weight between 0.39 g and 88.64 g, with an average of 23.97 mm in length and 31.24 g in weight. Faster grwoth was observed during the first, third and seventh months of the rearing period. During these ten months, the fish gained a net increase of 239.7 mm in length and 312.39 g in weight indicating 0.8 mm length increase and 1.04 g of weight increment per day.

ii) Yield

The different size groups in length and weight at harvest are shown in figures 4 and 5 respectively. The milkfish at harvest ranged from 240 mm to 494 mm in length and 80 g to 780 g in weight. About 53.5% of the total harvested fish had grown above average size. The harvest yielded 213 kg. denoting a calculated production rate of 852 kg/ha. The survival rate was 63%. A total of 1990 kg of artificial feed was supplied to the fish to achieve a net weight increase of 200 kg. The gross conversion ratio for the feed was 9.95 : 1.

Remarks on the results of 1980-81 experiments:

In the culture experiments conducted earlier in 1980-81, 1000 fingerlings of milkfish were stocked in the same pond in September '80, at a stocking rate of 4000/ha. The average size at stocking was 59.2 mm (1.9 g). Supplementary feeding was not attempted. However, in order to promote algal growth, the pond was manured with 250 kg of organic manure (chicken droppings) before stocking. Subsequent to stocking, 5 kg of inorganic fertilizer NPK (12:24:12), was supplied fortnightly. The size of the milkfish showed an increase from 59.2 mm (1.9 g) to 159.1 mm (32.7 mm in three months, 188.5 mm (54.8 g) in six months and 211.9 mm (60.2 g) at harvest (at the end of ten months). The average monthly growth recorded was 15.27 mm in length and 5.83 g in weight. The yield was 54 kg of milkfish (216 kg/ha) with a survival rate of 89.7%. The minimum and maximum size of milkfish at harvest were 184 mm (44 g) and 248 mm (78 g) respectively. 41% of the harvested fish were found to have grown above the average size.

Polyculture of milkfish with mullet

Pond preparation

During 1981-82, milkfish was cultured along with mullet in two ponds, each of 450 sq.m. Seawater sup-

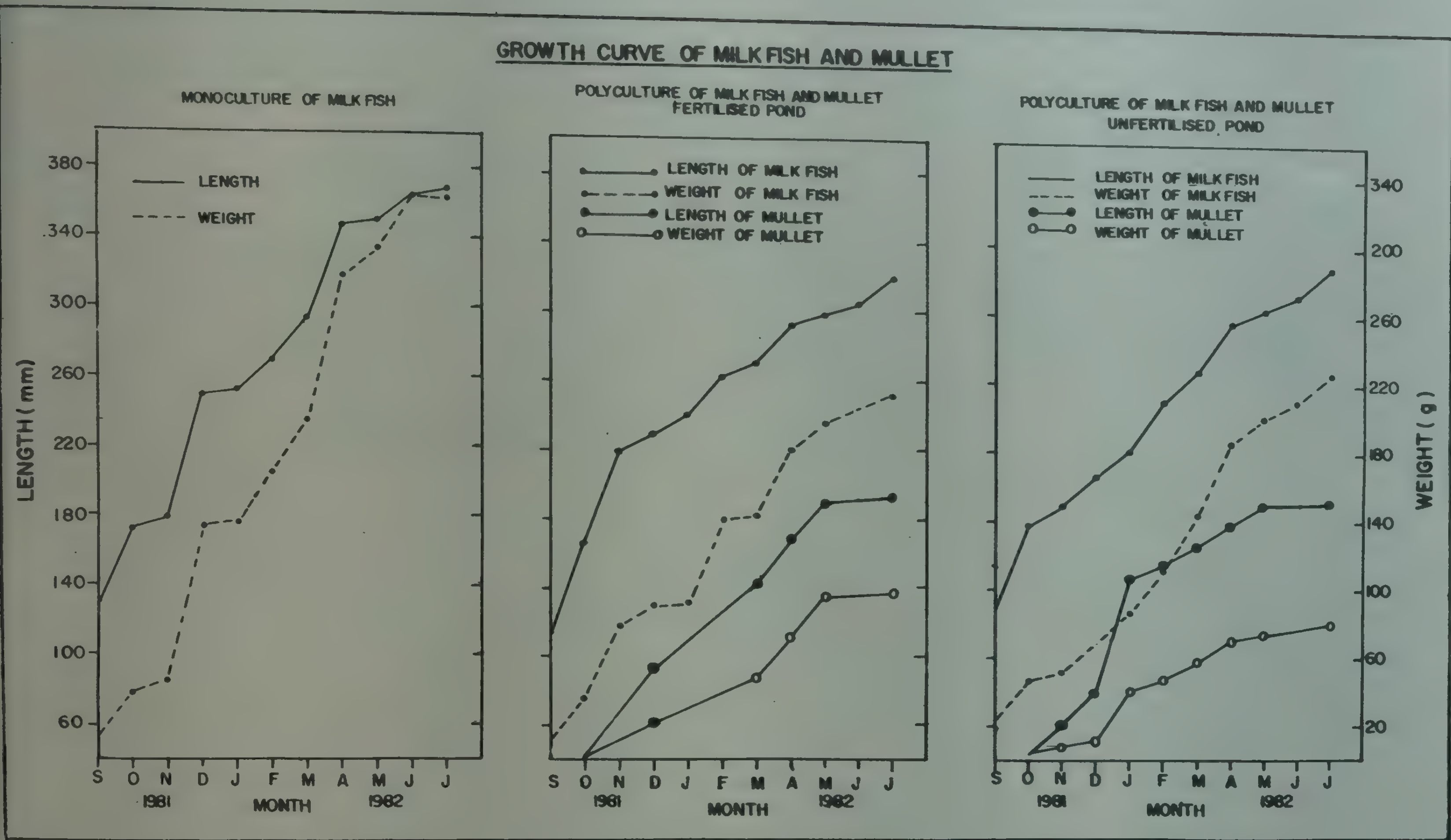


Fig. 3. Growth curve of milkfish and mullet in monoculture and polyculture experiments.

ply to the ponds was maintained by direct pumping. Of the two ponds, one was fertilized with organic manure at the rate of 1000 kg/ha initial application and thereafter once in three months at a rate of 500 kg/ha. The other pond was not fertilized.

Stocking

The milkfish seed were collected from tidal pools and streams at Manoli Island and Pillaimadam lagoon whereas the mullet seed were collected from Thonithurai area along the Palk Bay side of Mandapam. These were reared indoor in 12′ dia pools for one month prior to stocking in ponds. In both ponds, 375 fingerlings of milkfish *(Chanos chanos)* were stocked in September, '81 and after one month 350 fingerlings of mullet *(Valamugil seheli)* were stocked at an overall stocking rate of 16000/ha. The stock in both ponds were given (daily once) supplementary feed, of rice bran and groundnut oil cake mixed in equal proportion, in the form of dough, at a rate of 5–10% of the body weight. The environmental conditions of these ponds were regularly monitored (Fig.2). Harvesting was done in July '82. The results obtained from fertilized and unfertilized ponds were treated separately.

Results

Fertilized pond

i) Growth

The growth pattern of milkfish and mullet are given in Fig.3. The milkfish grew to a size of 229.2 mm (88.6 g) in three months, 271.5 mm (143.4 g) in six months and 322.7 mm (213.0 g) at harvest (at the end of ten months) from the initial average size of 109.9 mm (12.8 g). The monthly length increment was from 6.0 mm to 57.0 mm and the weight from 7.0 g to 47.2 g. The average monthly increase worked out to 21.3 mm and 20.0 g in length and weight respectively. Growth was noticed to be better in the first, second, fifth and seventh months.

The mullet attained a size of 88.8 mm (11.7 g) in two months, 170.6 mm (73.4 g) in six months and 195.0 mm (97.6 g) at harvest at the end of nine months from the initial average size of 42.5 mm (2.5 g). The growth per month ranged between 2.7 mm and 27.8 mm in length and 0.8 g and 25.4 g in weight with a monthly average of 16.9 mm and 10.6 g in respect of length and weight.

ii) Yield

Harvest done in July '82 yielded a total of 58 kg of milkfish and 4 kg of mullet which works out to a calculated production rate of 1289 kg/ha for milkfish and 89 kg/ha for mullet. The survival rate of milkfish and mul-

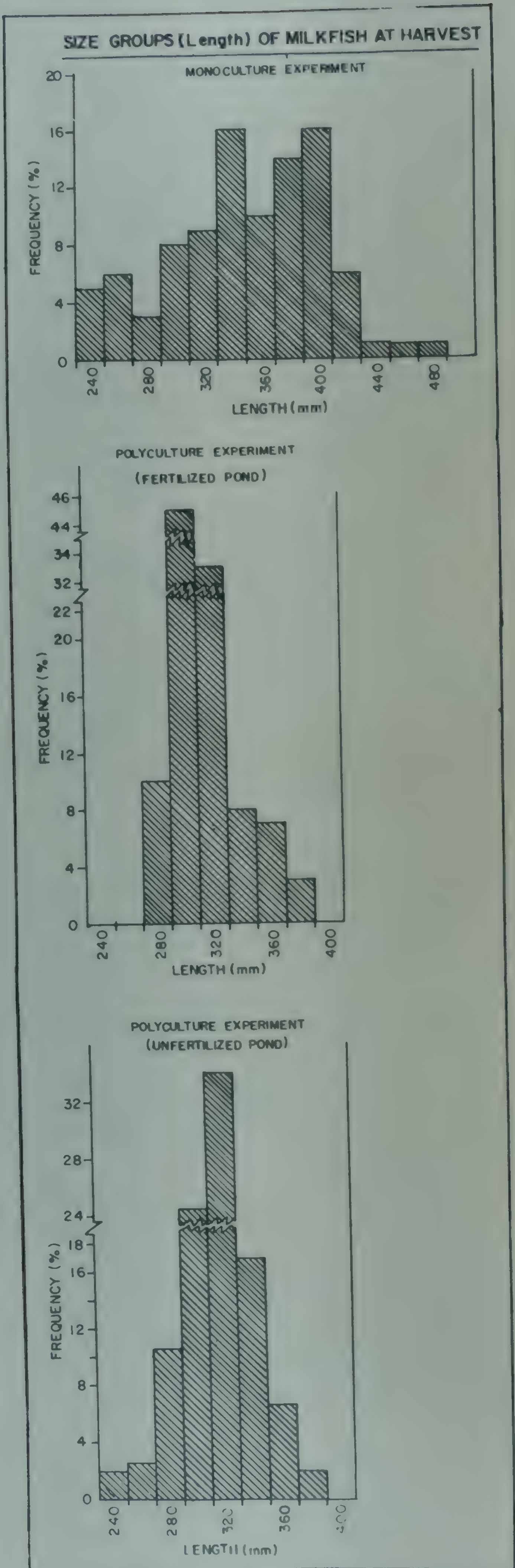


Fig. 4. The length groups of milkfish in the monoculture and polyculture at harvest.

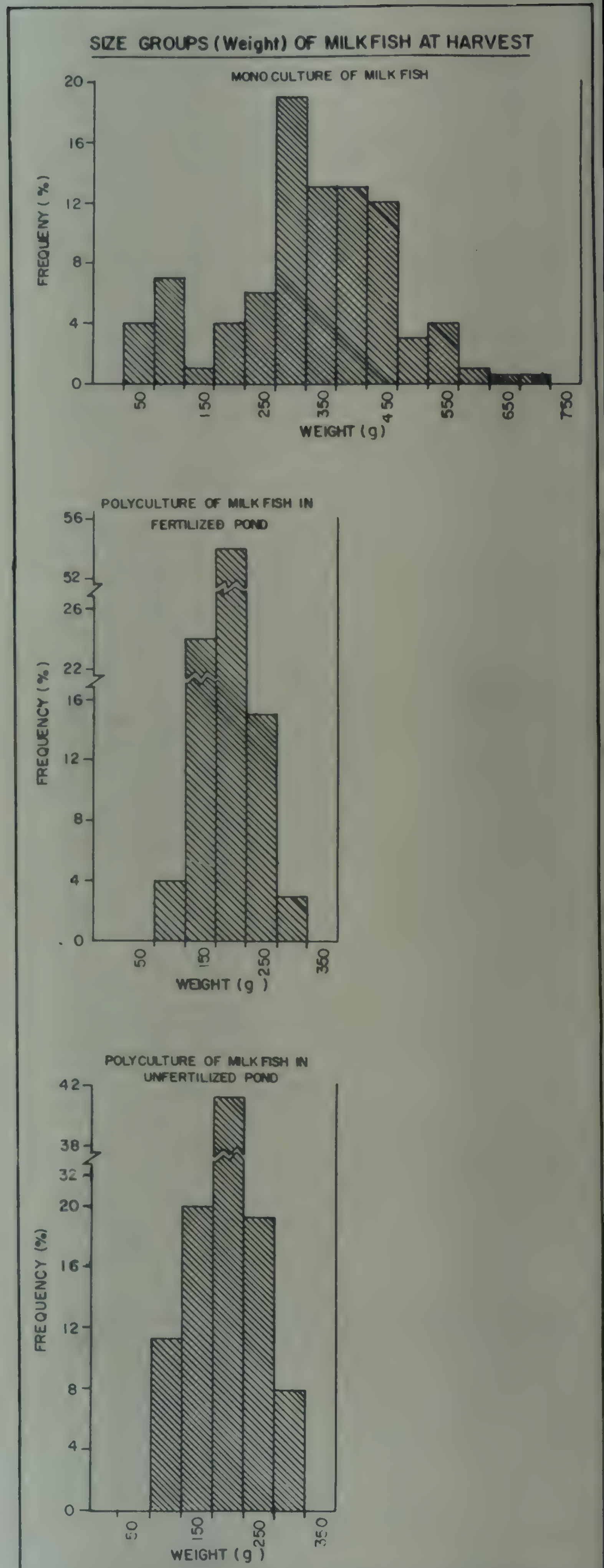


Fig. 5. The size groups (weight) of milkfish in the monocultur[e] and polyculture at harvest

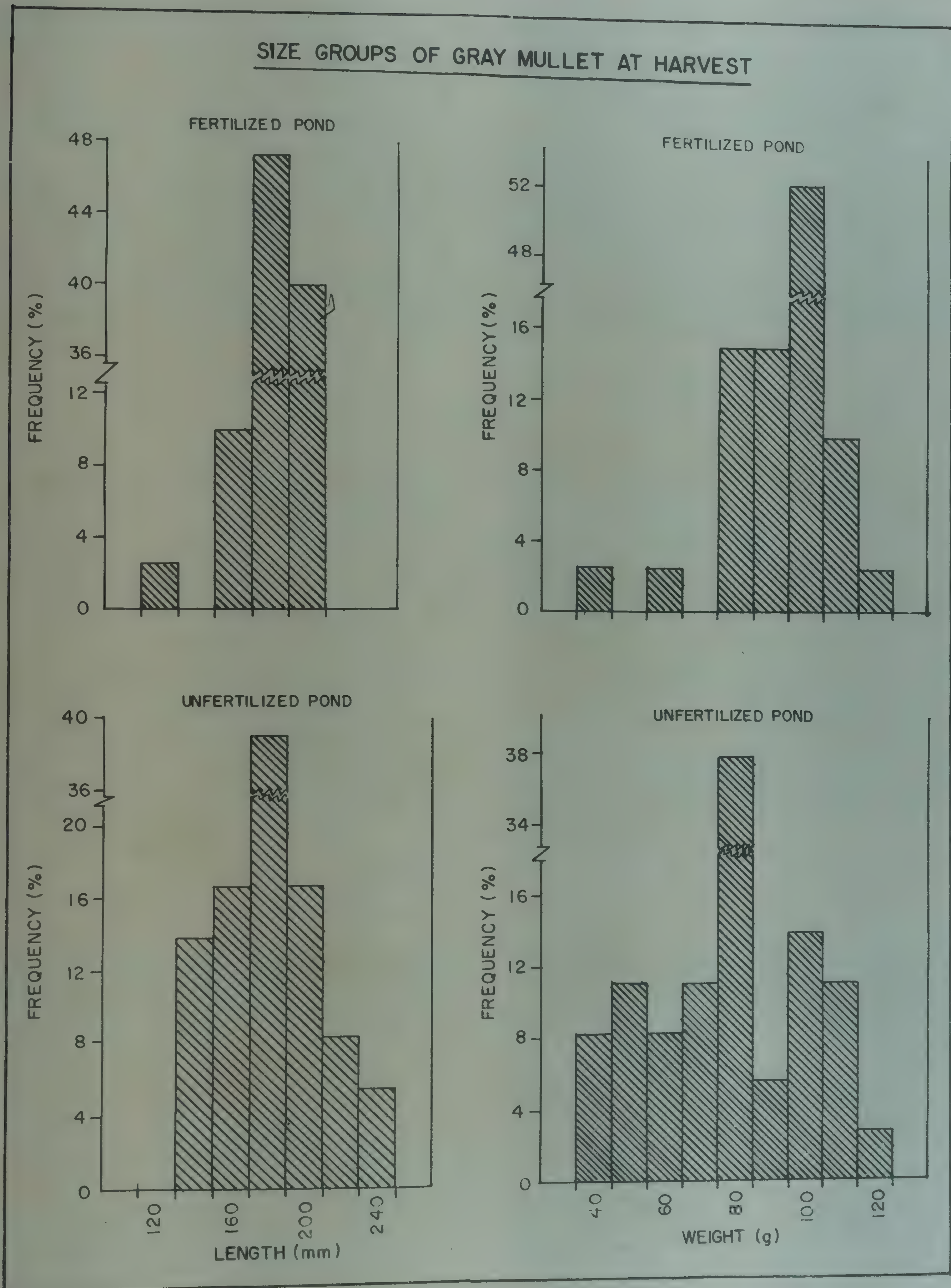


Fig. 6. The size groups (length and weight) of grey mullet in the polyculture at harvest.

let was 81.2 and 11.4% respectively. The size of milkfish at harvest ranged from 283 mm (120 g) to 397 mm (300 g). About 39% of the harvested milkfish had grown above the average size. The size groups of milkfish at harvest both lengthwise (Fig.4) and weightwise (Fig.5) are indicated. The size range of mullet at harvest was from 120 mm to 218 mm in length and 40 g to 120 g in body weight with about 57% of fish grown above the average size (Fig.6).

Remarks on the results of 1980-81 experiment

Similar experiment in the same pond with indentical stocking density was conducted during September- June of the preceeding year (1980-81) also. The average size of milkfish and mullet fingerlings at the time of stocking was 91.6 mm (10.6 g) and 50.6 mm (2.0 g) respectively. At harvest, the milkfish had grown to an average size of 360.0 mm (270.0 g) and the mullet to 190.1 mm (75.0 g). The monthly growth rate ranged between 3.4 mm (1.3 g) and 48.8 mm (60.7 g) with an overall monthly average of 26.5 mm (25.9 g) for milkfish and for the mullet between 7.8 mm (1.0 g) and 21.0 mm (15.8 g) with an overall monthly average of 15.5 mm (8.1 g). Th actual yield at harvest was 57 kg (calculated yield 1267 kg/ha) of milkfish and 15 kg (calculated yield 333 kg/ha) of mullet with a survival rate of 60.8% and 57% respectively. The percentage of milkfish and mullet which had grown above the average sizes was 49% and 62% respectively.

Unfertilized pond

i) Growth

Milkfish fingerlings increased from the average stocking size of 121.9 mm (21.2 g) to 206.5 mm (68.3 g) in the first three months, 267.2 mm (143.2 g) at the end of six months and 329.1 mm (227.2 g) at the end of ten months, at harvest (Fig.3). The range in monthly increase was from 4.9 mm to 54.9 m in length and 6.2 g to 44.9 g in weight with an overall monthly average of 20.7 mm and 20.6 g respectively. The growth of milkfish was better in 1st, 5th and 7th month of the rearing period.

ii) Yield

As in the case of the fertilized pond, harvest was done in July, '82. 63.25 kg of milkfish and 2.9 kg of mullets were harvested which worked out to a calculated production rate of 1405 kg/ha for milkfish and 64 kg/ha for mullet with a respective survival rate of 86.7% and 10.3%. The harvested milkfish ranged in size from 245 m (100 g) to 398 mm (340 g) with about 44.7% of total fish grown above the average size. The size groups in length (Fig.4) and in weight (Fig.5) at harvest are indicated. The mullet which ranged from 150 mm (40 g) to 250 mm (120 g) at harvest showed a percentage of 53% above the average size (Fig.6).

Remarks on the results of 1980-81 experiment

During the preceding year (1980-81) identical experiment was conducted in the same pond. The average size of milkfish and mullet fingerlings at stocking were 65.9 mm (2.5 g) and 57.0 mm (3.0 g) respectively. The milkfish grew to an average size of 343.3 mm (249.0 g) at harvest at the end of 10 months and the mullet to 190.9 mm (65.0 g) at harvest at the end of 9 months. The monthly growth rate ranged from 7.6 mm (0.8 g) to 69.6 mm (80.0 g) for the milkfish and 7.3 mm (1.0 g) to 33.6 mm (23.3 g) for the mullet, with an average growth increase of 27.7 mm (24.6 g) and 14.9 mm (6.9 g) respectively. The total quantity of fish harvested was 54.25 kg of milkfish (1205 kg/ha) and 9.75 kg of mullet (217 kg/ha) with a recovery rate of 65% for the former and 42.9% for the latter, 49% and 57% in respect of total harvested milkfish and mullet recorded above the average size.

General Remarks

From the foregoing results it is apparent that in the monoculture of milkfish the average size of the fish as well as the production rate could be substantially stepped up by resorting to supplementary feeding. It is interesting to note that the average growth rate of 24 mm and 31 g per month obtained in 1981-82 experiments is higher when compared with the results obtained by Thampi (1960) in the same area. With regard to polyculture of milkfish, the average growth rate was found to be more or less similar in both the fertilized and unfertilized ponds. However, the survival and production rates were higher in unfertilized pond when compared with those of the fertilized pond. The salient features of the culture operations are presented in Table 1.

The milkfish production in the present experiment is found to be much better than in Thailand, where on an average 560 kg/ha/yr was produced (Arporna Sribhaibhadh, Fishing News (Books) Ltd: 74-83, 1970). The yield of milkfish under monoculture in the present study is comparable to that of Ceylon, where selective harvesting followed by replenishment gave a production of 799 to 1159 kg/ha/annum. A production rate of 1405 kg/ha/10 months obtained in the present experimental polyculture of milkfish is similar to the yield of 1338 kg/ha realised at the reclaimed tidal land of Taiwan (Jium-Kuo Liang and Chin-Yun Huang, Fishing News (Books) Ltd: 417-28, 1970). Although more confirmatory data are needed to findout the actuals, the experiments conducted by CMFRI at Mandapam have helped to demonstrate the feasibility of culturing milk-

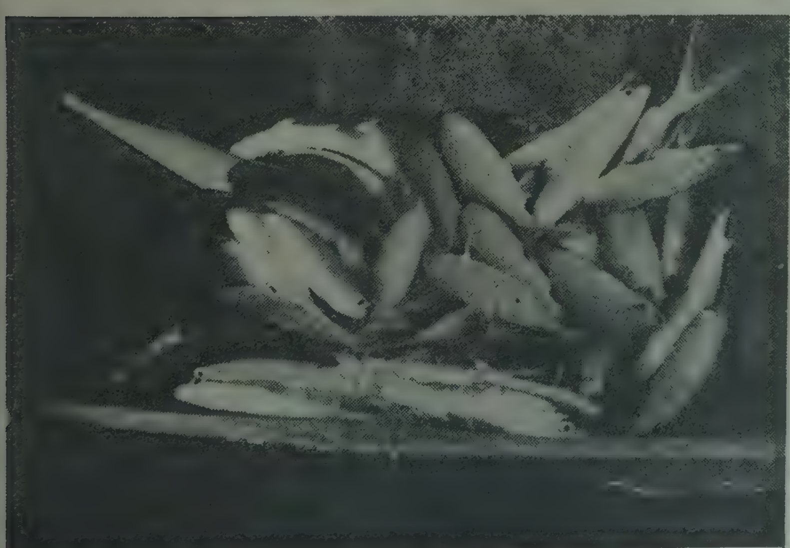
a

b

c

d

e



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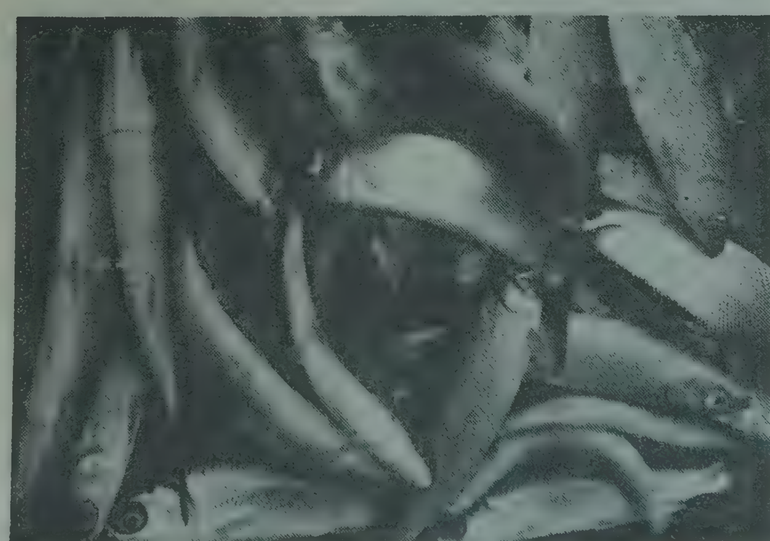


Plate. I. (a f) showing the sequence of operation of the net and the catch of milkfish at harvest.

Table 1. *Culture of milkfish and mullet during the period 1981-'82 at Mandapam*

Sl. No.	Particulars	Monoculture (Un-Fertilized) Pond	Polyculture (Fertilized) Pond		Polyculture (Un-Fertilized) Pond	
1.	Size of the pond	0.25 ha	0.045 ha		0.045 ha	
2.	Name of the Species	Milkfish	Milkfish	Mullet	Milkfish	Mullet
3.	No of seed stocked	1000	375	350	375	350
4.	Stocking rate per hectare	4000	8333	7777	8333	7777
5.	Date of stocking	20.9.81	14.9.81	14.10.81	14.9.81	14.10.81
6.	Size at stocking					
	a) Average length (mm)	129.0	109.9	42.5	121.9	42.5
	b) Average weight (g)	13.0	12.8	2.5	21.2	2.5
7.	Date of harvest	21.7.82	19.7.82	19.7.82	18.7.82	18.7.82
8.	Culture period (Days)	303	303	274	303	274
9.	Size at harvest					
	a) Average length (mm)	368.7	322.7	195.0	329.1	190.0
	b) Average weight (g)	325.9	213.0	97.6	227.2	80.0
10.	Growth rate (Monthly average) a) length (mm)	24.0	21.3	16.9	20.7	16.4
	b) Weight (g)	31.2	20.0	10.6	20.6	8.6
11.	Total quantity harvested (Kg)	213.0	58.0	4.0	63.250	2.9
12.	Production rate (Kg/ha)	852.0	1289.0	89.0	1405.0	64.0
13	Survival rate (%)	63.0	81.2	11.4	86.7	10.3

fish in coastal seawater ponds, which are considered biologically less productive.

Seasonal abundance of the milkfish seed in the nearby areas of Mandapam confers specific advantage in undertaking milkfish culture here. In addition to Chinnapalam creek and Pillaimadam lagoon which are well known potential grounds for milkfish seed, recent attempts made by this team brought to light the existence of more extensive areas near Mandapam for attempting large-scale collection of fry and fingerlings of milkfish and mullet.

The authors wish to express their very sincere gratitude to Dr.E.G.Silas, Director, Central Marine Fisheries Research Institute, Cochin for his constant encouragement throughout the period of this study. They are thankful to Dr. P.S.B.R.James, then Joint Director and Project leader for the guidance. They are also thankful to Shri S.Mahadevan, Officer-in-Charge for critically going through the manuscript and for the suggestions for improvement and Shri K. Dorairaj for the help in the preparation of this account.

FLUCTUATIONS IN THE MACKEREL CATCHES AT COCHIN*

On 21st and 28th September 1982, heavy catches of mackerel were landed by purse seiners at the Fisheries Harbour, Cochin, the estimated landings being 293.529 and 108.999 tonnes respectively. Since such heavy landings are quite unprecedented in the recent past, observations made on the biology of the fish and its fishery are presented.

The particulars of number of units, catch and catch per unit at Cochin during September 1982 are presented in Table 1. On 21st September, 56 purse seiners and 110 carrier boats landed 293.529 tonnes of mackerel at 5241.589 kg per unit. In the morning of the day when the purse seiners and carrier boats started arriving with catches, the auction price ranged from Rs.4550/- to Rs.4900/- per tonne of mackerel (Figs. 1 & 2). As the boats continued to bring in heavy catches, the price declined to Rs.1500/- per tonne of fish later in the day. On the following day, the mackerel catch came down to 16.059 tonnes at a catch rate of 297.389 kg per unit. On 28th instant, mackerel landings were good aggregating 108.999 tonnes at 2018.500 kg per unit. But, the fish merchants were not prepared to buy the catches as there was poor demand for fish in the market (being Bakrid). The catches of 28th continued to come till the early hours of 29th instant. On 29th morning, the catches were found strewn all over the Fisheries Harbour. The price came down to Rs.700/- per carrier boat of 1.8 to 2.0 tonnes of mackerel. Most of the mackerel landed was spoiled and some of the lots were transported as manure. This glut of mackerel in the harbour affected the auction sale of drift net catches. The price of cat fishes, pomfrets, horse mackerel, seer fishes, etc., declined drastically resulting in a fall in the average income per drift net boat from Rs.500/--525/- in the previous week to about Rs.240/- in the week under reference. The total estimated landings of mackerel in September 1982 aggregated 1026.222 tonnes which, incidentally, is the highest montly catch recorded at Cochin since March 1981 (catch: 1055.407 tonnes).

The size-ranges and dominant modal sizes of mackerel in the purse seine catches at Cochin in September 1982 (observation day-wise) are given in Table 2. The overall size-range of the fish during the month was 153-276 mm and the modal sizes varied between 180 and 250 mm suggesting that the fishery was supported mainly by 1-year and 2-years-old individuals. A majority of fish (58%) were in spent condition followed by immature, spent-recovering and developing individuals. The bulk (92%) of the bumper catch of 21st September comprised spent fish followed by spent-recovering individuals. These were 2-years-old.

The mackerel catches in Kerala State, constituting on an average about 30% of the landings in India, have been showing a declining trend from 1978 through 1982, the catches in the concerned years being 25917, 18585, 18474, 16200 and 10717** tonnes respectively. At Manassery,, Cochin, the mackerel fishery by indigenous boats operating Thangu vala (boat seine) and Ayila vala (gill net) has been sporadic and poor in 1978 and 1979, the landings being 521.449 and 387.325 tonnes respectively. With the introduction of purse seining on a commercial scale in 1979, the fishery improved considerably. The month-wise mackerel landings and catch per unit effort by purse seiners at Cochin during August 1979 – December 1982 are delineated in Table 3. The total landings of mackerel by purse seines, drift nets and trawl nets at the Fisheries Harbour, Cochin during 1979, 1980, 1981 and 1982 aggregated 248.989, 4359.363, 3948.141 and 2158.698 tonnes respectively of which purse seines contributed 19.32%, 96.83%, 98.78% and 97.20% in the concerned years. In 1980, the purse seine fishery was better during post-monsoon months with high yields and yield rates particularly in October (1495.203 tonnes and 662.180 kg per unit) and December (1127.243 tonnes and 679.881 kg per unit). This trend of high yields and yield rates continued through the pre-monsoon season of 1981 when the returns registered high values (e.g., 1335.692 tonnes and 1649.002 kg per unit in February and 1055.407 tonnes and 1552.069 kg per unit in March). The fishery was moderately good through the 1981 post-monsoon and 1982 pre-monsoon seasons. But for the high yield recorded in September, during October through December 1982 the fishery exhibited almost the same trend as in the post-monsoon season of 1981. As compared to the landings during 1980 and 1981, those in 1982 were considerably less. The fall in the effort expended during these years was rather marginal (9580, 8870 and 8779 purse seine units in the respective years).

The month-wise delineation of the catch data, however, does not give a true picture of the sporadic nature and magnitude of fluctuations in the mackerel fishery at Cochin. On an average, the number of days expended for fishing by purse seiners is 25 or 26 in a

*Prepared by M.V.Pai, K.V.Somasekharan Nair, A.A.Jayaprakash and M. Abdul Nizar.

** Provisional

Table 1. *Particulars of the purse seine mackerel fishery at the fisheries Harbour, Cochin in September 1982.*

Date of observation	Number of units operated		Mackerel	
	Purse seiners	Carriers	Catch (kg)	Catch per purse seiner (kg)
4.9.1982	33	28	71409	2163.909
17—	52	35	63499	1221.135
21—	56	110	293529	5241.589
22—	54	46	16059	297.389
24—	54	40	47932	887.630
28—	54	52	108999	2018.500

Table 2. *Size ranges and dominant modal sizes of mackerel in the purse seine catches at the Fisheries Harbour, Cochin in September 1982.*

Date of observation	Size-range (mm)	Dominant modal size + (mm)
4-9-82	170—240	190, 200
17—	225—272	240
21—	228—275	230, 245
22—	215—276	235, 250
24—	153—222	180, 190
28—	220—270	235

+ Mid-points of size-groups.

Fig.1. A purse seine carrier boat with mackerel at the Fisheries Harbour, Cochin.

month. An examination of the catch statistics of the Fishery Resources Assessment Division of the CMFRI suggests that on a majority of fishing days in a month the mackerel catch of purse seiners is highly negligible or even nil, the total landings of the month being made up of the good catches of certain days only. It is possible that mackerel shoals do not occur in sufficient concentration in the present fishing belt, even after extension of the fishing area by purse seiners. In Table 4 are presented the maximum mackerel catches and catch per unit effort recorded on certain days by purse seiners at Cochin during August 1979-December 1982. If Tables 3 and 4 are read in conjunction with each other, the reasoning that the total landings of a month are constituted by the good catches of certain days only becomes obvious.

When Thangu vala was the principal gear employed in the mackerel fishery in the inshore belt of 4-10 km from Cochin, the fishery which was of small magnitude exhibited two phases, one of occurrence of juveniles during May-August and another of commercial sizes during October-April, with negligible or nil catches in September. With the extension of the area of fishing by purse seiners in 1979, the fishery exhibited a different picture since then-of large catches and very good catch rates of mainly adults in the pre-monsoon months of certain years and of predominantly juveniles in the post-monsoon period of certain other years (vide Table 3). It is interesting to note that on

Table 3. *Mackerel landings (kg) and catch per unit effort (kg) (in parenthesis) by purse seiners at the Fisheries Harbour, Cochin during August 1979—December 1982.*

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.Jul.Aug.	Sep.	Oct.	Nov.	Dec.	Total
1979	—	—	—	—	—	— — ++	++	17565 (87.388)	28545 (102.312)	2000 (7.143)	48110 (58.386)
1980	15985 (53.822)	40247 (105.359)	116767 (197.242)	112289 (111.287)	287150 (354.506)	No operation	329183 (322.728)	1495203 (662,180)	696961 (448.495)	1127243 (679.881)	4221028 (440.608)
1981	59195 (65.699)	1335692 (1649.002)	1055407 (1552.069)	476030 (587.691)	239073 (283.262)	" "	319951 (325.484)	392323 (313.107)	15507 (12.998)	6688 (4.791)	3899866 (439.669)
1982	11110 (8.341)	314094 (283.478)	68631 (109.810)	154243 (119.476)	151366 (132.197)	" "	1026222 (846.718)	355158 (309.102)	5047 (12.875)	12352 (23.528)	2098223 (239.005)

++No mackerel in the purse seine catches.

Table 4. *Maximum mackerel catches (kg) and catch per unit effort (kg) (in parenthesis) on certain days by purse seiners at the Fisheries Harbour, Cochin during August 1979—December 1982.*

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.Jul.Aug.	Sep.	Oct.	Nov.	Dec.
1979	—	—	—	—	—	—	—	18th 7660 (957.500)	15th 7500 (277.778)	27th 1000 (62.500)
1980	18th 3250 (406.250)	26th 8238 (374.455)	10th 30546 (872.743)	26th 33274 (627.811)	2nd 39092 (1699.652)	No operation	26th 127987 (1777.597)	13th 262471 (2322.752)	13th 66933 (1365.980)	24th 226420 (2902.821)
1981	3rd 12500 (367.647)	20th 186575 (4664.375)	2nd 92380 (3849.167)	18th 89320 (1488.667)	28th 103390 (2067.800)	" "	5th 66120 (1889.143)	6th 122090 (2219.818)	23rd 3033 (58.327)	8th 2040 (53.684)
1982	30th 1942 (37.346)	11th 62980 (1049.667)	18th 20825 (833.000)	12th 35453 (644.600)	17th 13707 (274.140)	" "	21st 293529 (5241.589)	5th 55500 (1067.308)	19th 1350 (54.000)	17th 3720 (97.895)

Fig.2. Bumper catch being packed for the market.

some days in September (vide Table 1) high catches and catch rates were obtained which indicates that the mackerel shoals available in the inshore waters were not adequately exploited before the introduction of purse seiners in the area (vide Table 3). Several hypotheses have been put forward for the shore-ward coastal migration of mackerel and the resultant wide fluctuation in the fishery. The significance of temperature and salinity in the availability of mackerel has been established by comparing the monthly mackerel landings and values of temperature and salinity at different centres by various authors. Certain optimal levels of temperature and salinity have been found to be good for the mackerel fishery.

PRELIMINARY OBSERVATIONS ON FISH PEN CULTURE IN A LAGOON AT MANDAPAM*

Introduction

Fish pens of various designs are in operation in countries like Philippines, Taiwan, Hongkong and Indonesia. Small fish enclosures were tried experimentally in Pulicat lake, Killai backwaters, Tuticorin Bay and Palk Bay. In the present study large fish pens of area 0.25 ha (50 × 50 m), 0.5 ha (100 × 50 m) and 1 ha (100 × 100 m) respectively were fabricated in the Pillaimadam lagoon near Mandapam Camp adjacent to the Palk Bay for culturing fishes. (Fig.1).

Location of culture area

The Pillaimadam lagoon is situated along the Mandapam coast (09° 17′N and 79° 06′E) adjacent to the Palk Bay. The maximum water spread of the lagoon during November-December is about 400 ha extending for about 5.2 km in length and 500 to 800 m in width. The lagoon was earlier reported to have two bar mouths opening into the Palk Bay. But now the opening at the western end has got closed and that has affected the topographical and the Physiochemical characteristics of the lagoon to a great extent. Though water is found throughout the year in the deeper parts of the lagoon, it dries up exposing the major part during September-October when the south west wind is strong. During the north east monsoon from November-December, the lagoon receives rain water mainly through the Pillaimadam creek, the main fresh water inlet of the lagoon

Based on the topography of the lagoon, it can be divided into 3 zones, the shallow eastern zone upto the bar mouth with 5-15 cm of mud, the middle zone between the bar mouth and the fresh water inlet with 10-40 cm of mud and the western shallow part beyond the fresh water inlet with 5-20 cm of mud. The deeper parts are restricted to the middle zone where the water is locked up through out the year (Fig.1). This area is suitable for culture of fishes through out the year in net enclosures or fish pens. Other areas can be utilised for culture for only about 6-8 months when there is water.

The bottom sediment consists of 48% of fine sand, (300-600 micron), 35% of coarse sand (600-1200 micron) and 11% of very fine sand (150-300 micron) and 2% silt (75-150 micron) in this middle zone. The mud contains 48 ppm/100 g nitrogen, 33 to 44 ppm/100 g phosphorus (P) and 253-385 ppm/100g Potassium (K). The pH of the mud ranges between 8.5 and 9.0 indicating alkaline condition and the electric conductivity from 7.0 to 7.2 mhos/cm.

The hydrological condition of the lagoon varies greatly. The salinity ranges between 22 and 180 ppm. The high saline condition is observed during September to October when the bar mouth is closed and the evaporation at the maximum. The dissolved oxygen of

*Prepared by R.S. Lal Mohan

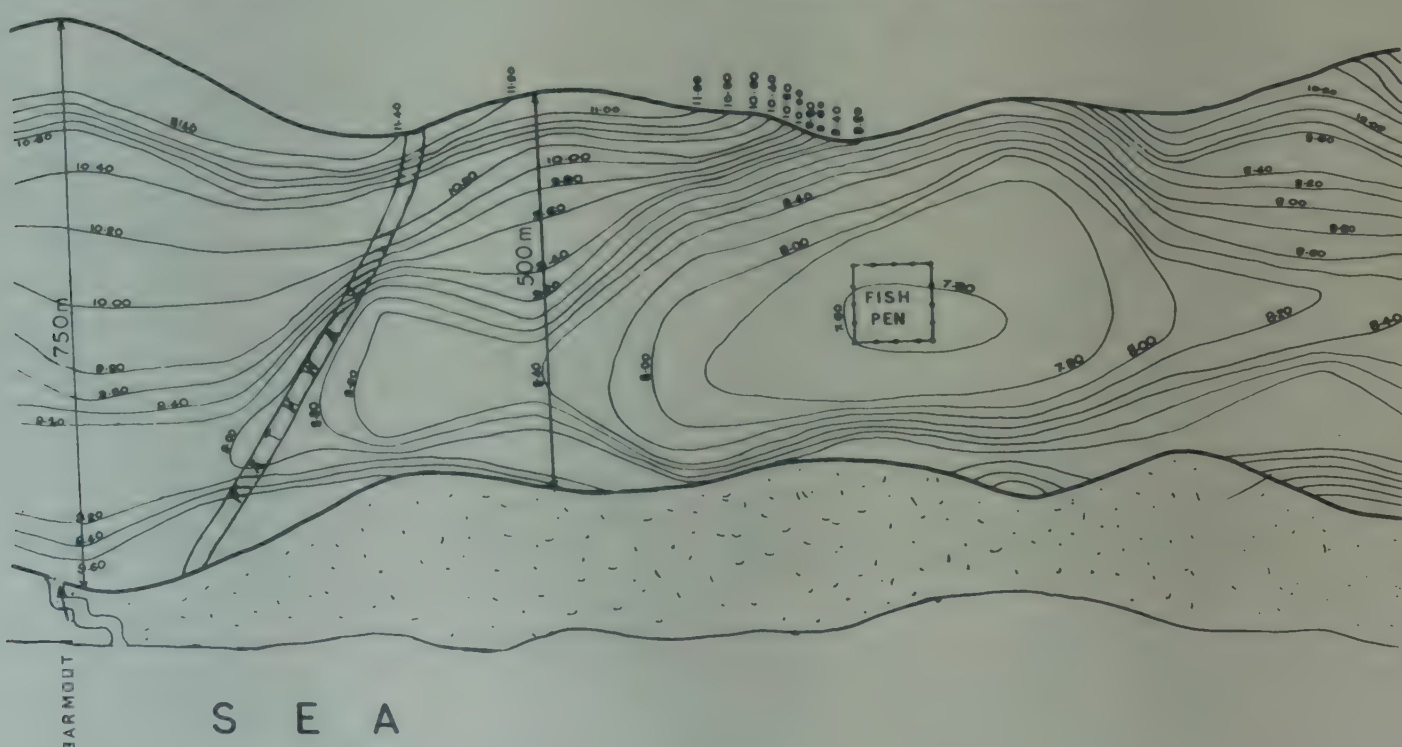
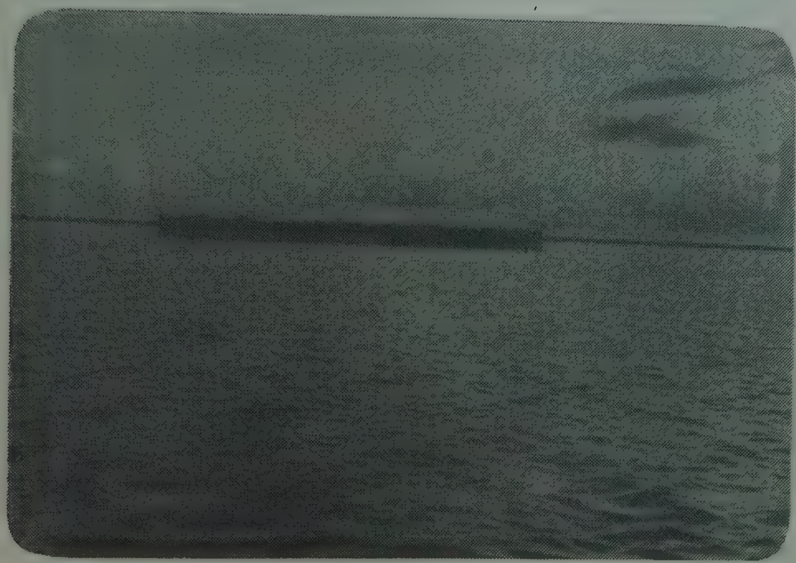


Fig.1. Contour map of lagoon area where fish pen was located



the lagoon varies between 2.1 and 6.0 ml/l and water temperature between 26° to 34°C. The productivity is almost nil during October when the salinity is very high (106.5 ppm), but increases to 951.9 mg C/m2/day as the salinity decreases (44.5 ppm) in January.

Potentiality of large scale fish culture in the Pillaimadam lagoon has been stressed by earlier workers. One of the advantages of the area is the availability of large number of milk fish seed in the lagoon during April-May.

Fish pens

Large fish pens covering an area of 0.25 ha (3 numbers), 0.5 ha and 1 ha were designed and fabricated (Fig.2, 3) in the lagoon taking into consideration various topographical features of the lagoon such as depth and soil condition. The fish pens were made of Palmyra poles and nylon webbing. The palmyra poles, 3.5 m long, 10 cm wide and 5 cm thick were used. The poles were planted 75 cm deep at an interval of 1.5 m with the help of a crow bar. An iron nail at the top of each pole served for attaching the head rope, a 3 mm nylon rope inserted through the upper meshes of the webbing. The webbing was made of 0.75 mm nylon twine with 20 mm mesh. The width of the webbing used was 3.5 m. The foot rope was inserted through alternate meshes of bottom free end. Laterite stones of about 500 g tied to the foot rope at an interval of 1.5 m served as sinkers. The webbing was securely placed on the nails at the top of the poles with the aid of the head rope. After allowing enough slackness tc the webbing i.e. 1 m slackness to 10 m of webbing, the sinkers were buried at a depth of 50 cm in between the poles. The lower end of the webbing was buried at a depth of 50 cm. The webbing was tied to the poles at an interval of about 1 m so that it was held tightly to the poles. An opening was provided at one of the corners. It could be closed by tying the free ends of the net to the poles after overlapping the webbing. A table made of palmyra poles measuring 2 × 1.5 × 1.5 m was provided near the gate for field observations (Fig.2, 3).

A scare line was provided inside the enclosure. The tender palmyra leaves of length 50 cm was tied to a nylon rope of 3 mm tickness at an interval of 1 m. The bright yellow colour of the palmyra leaves would

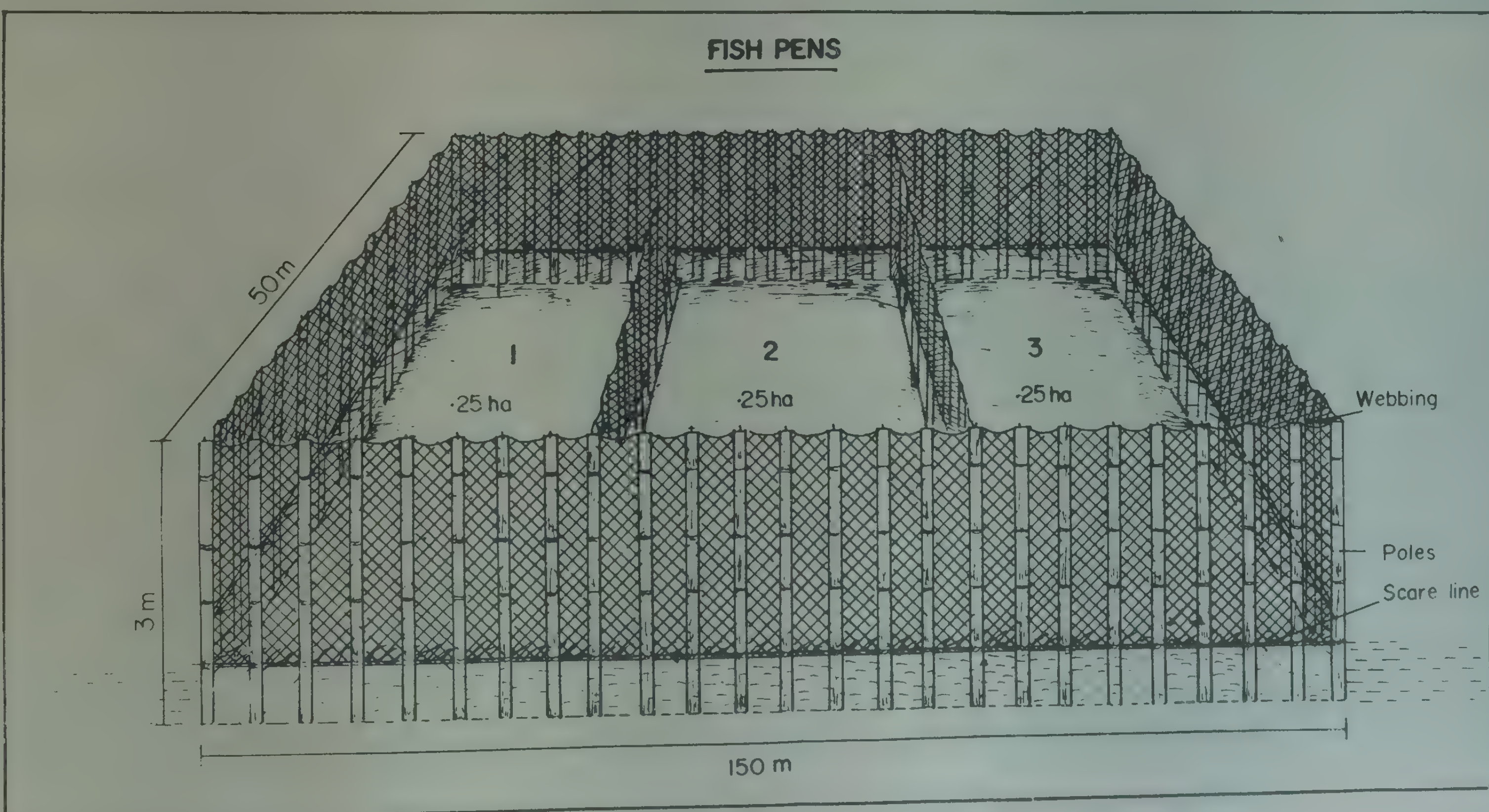


Fig.2. Three fish pens constructed in Pillaimadam lagoon

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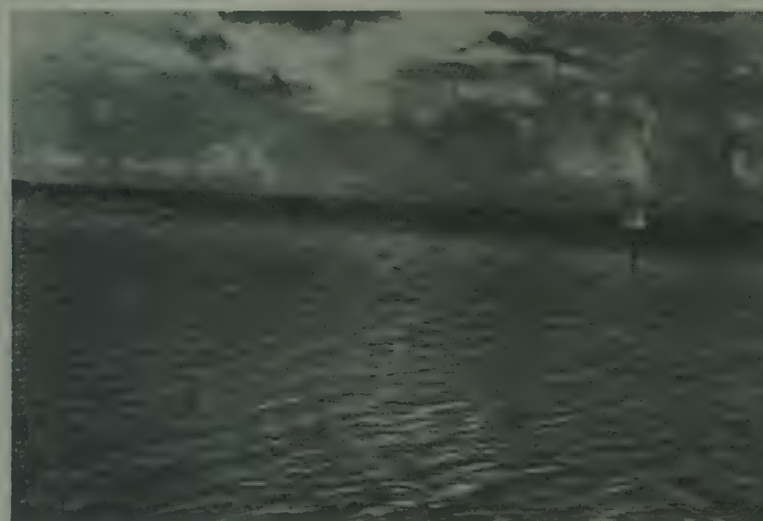

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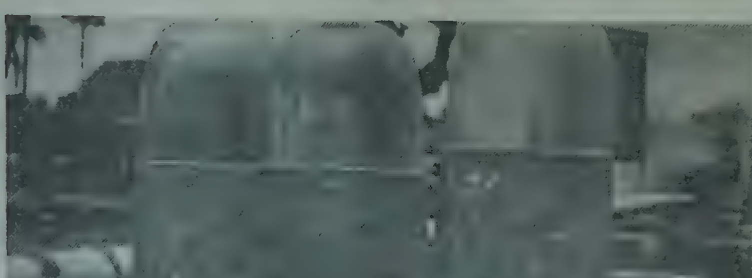

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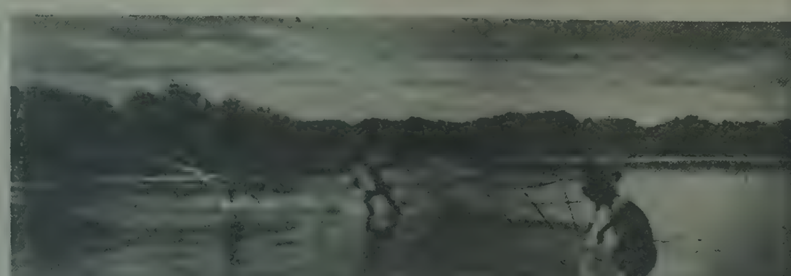


Figs. (a–f) Views of lagoon at Pillaimadam and preparations for pen culture in the lagoon.

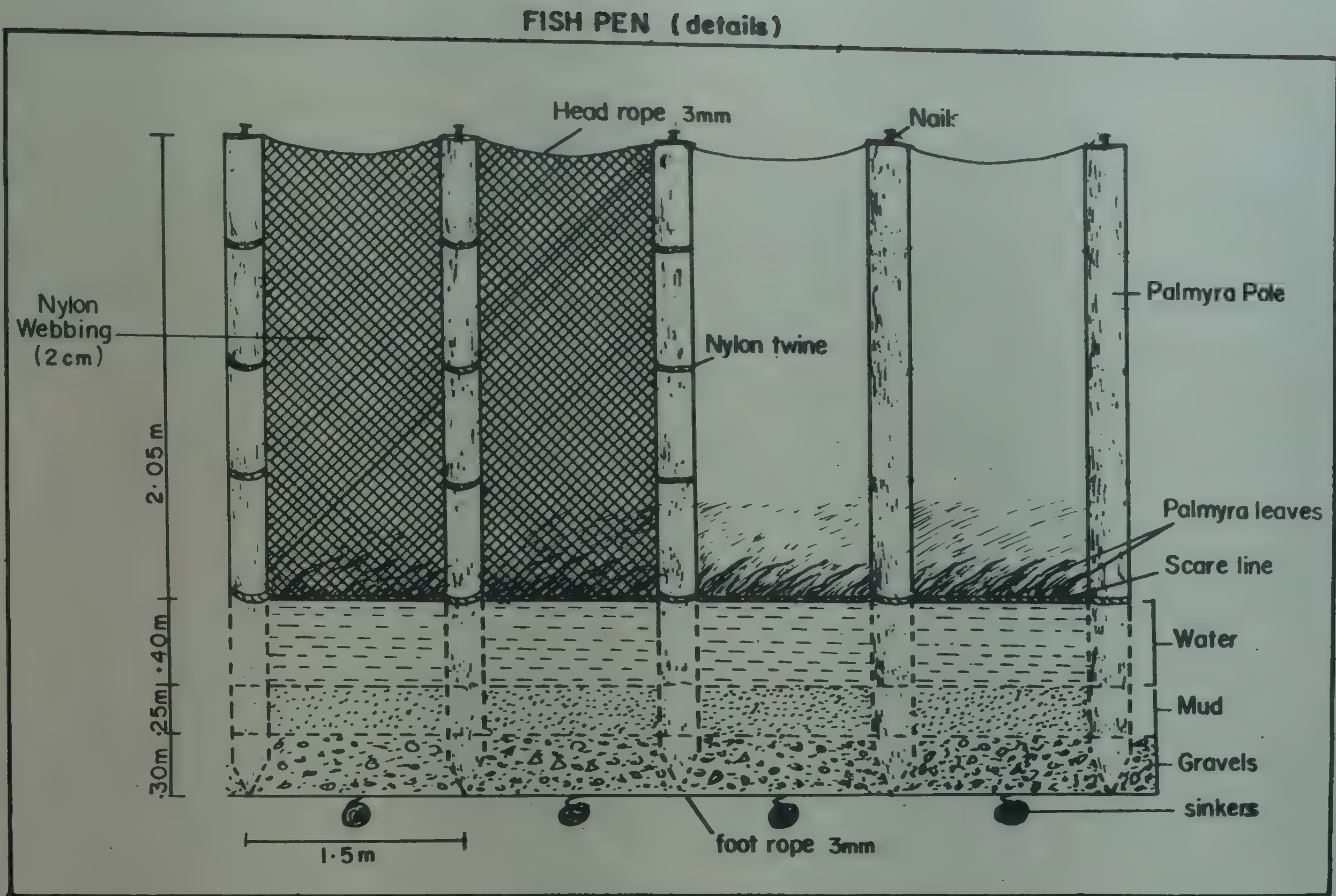


Fig.3. Details of construction of fish pens

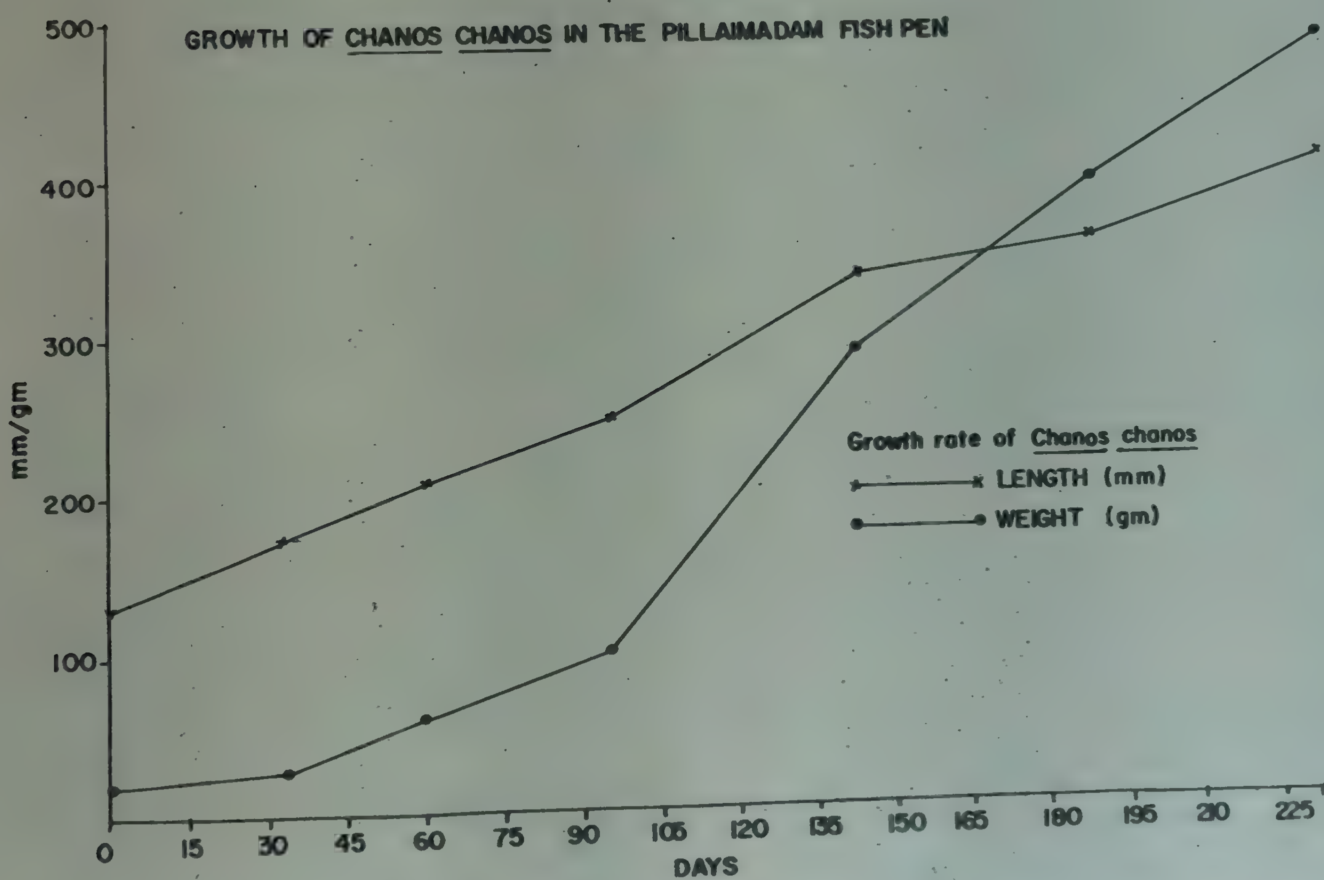


Fig.4. Growth of *Chanos chanos* in the fish pen

scare away the chanos fingerlings from coming near the webbing in their attempt to escape from the enclosure.

Stocking

Chanos fingerlings measuring 90-150 mm were collected mainly from the lagoon using a rectangular bag net measuring 12 m length, which was dragged behind a scare line made of tender palmyra leaves attached to a coir rope. The scared chanos fingerlings leap and fall into the net. The fingerlings were then transferred to plastic containers of 40 capacity and covered with nylon net. About 50 fingerlings were kept in a container and immediately transferred to the fish pen.

The 3 fish pens of 0.25 ha area each were stocked with 1000, 1500 and 2000 chanos fingerlings at the rate of 4000, 6000 and 8000 number/ha respectively.

Growth

The chanos fingerlings attained a length of 200 mm, weighing 63 g in 30 days in a 0.25 ha pen with the stocking rate of 4000/ha. The stocking size was an average of 140 mm weighing 25 g. In another pen it attained a length of 195 mm weighing 61.6 g in the first 30 days, 245 mm weighing 103 g in the next 36 days. The average growth was 1.5 mm/day. The growth rate was more or less same in the pen with the stocking of 8000/ha.

During the period of the experiment the salinity of the fish pens fluctuated from 60 to 169 ppm. The oxygen ranged from 3.8 to 4.5 ml/l.

In another experiment with a stocking rate of 6000/ha the fingerlings of length 74 mm in a 0.06 pen attained length of 405 mm weighing 400 g in 234 days (Fig.4). When salinity was about 32 ppm, a daily increment of 2.1 mm and weight 2.3 g was observed but the growth was very poor when the salinity was higher in the range of 65-70 ppm, indicating the influence of salinity on growth of the milkfish fingerlings.

These culture experiments are only preliminary. However, the possibility of making use of pens fabricated in these lagoon areas for culturing valuable fishes like milkfish and mullets is indicated. Thus large areas of water spread in this lagoon could be utilised for production of valuable protein food.

UNUSUALLY HIGH LANDINGS OF SOME PENAEID PRAWNS AT BOMBAY*

New Ferry wharf is an important trawl landing centre in Greater Bombay, forming the base of operation for nearly 400 boats, most of which make 3-4 day trips in an area about 200 km north and south of Bombay. In general in the year April 1982 to March 1983 larger quantities of prawns were landed at the centre in comparison to previous years.

Very heavy landings of particularly two species of penaeid prawns have been reported from this centre, especially in October and November 1982. One of the prawns is *Metapenaeus monoceros* which is a conventional species represented in the prawn fishery of Bombay waters, occupying fourth place in abundance in the fishery in previous years. Heavy landings of this species occurred during the fortnight beginning from the last week of October, contributing to nearly two thirds of the total landings of 2,027 tonnes of the species for the year and raising the species to the second rank in abundance. The catch per fishing trip at this time was 500-900 kg. Similar catches of the species (about 1000 kg per trip) have also been reported from Sassoon Dock, another landing centre in Greater Bombay (personal communication from Shri K.B.Waghmare). During this time the area of fishing is reported to be off Harnai about 130 km south of Bombay in 60-75 m depth zone. The sizes represented in these heavy catches ranged from 78 to 183 mm in total length with proportion of females more than twice that of males.

The other species which contributed to heavy landings, especially in the first and third weeks of October is *Metapenaeopsis stridulans*, which has never been earlier reported in such large quantities in the prawn fishery of Bombay. About 75% of the annual catch of 536 tonnes of the species in the year has been landed during this period. The catch per boat trip for the species at the time averaged to 140 kg. This is a small species ranging in size from 48 to 93 mm in total length.

The value of these two species is estimated at 91 and 2 million rupees respectively for the entire year. Nearly 70% of this value has been realised from the heavy catches occurring during October-November.

*Prepared by S. Ramamurthy and A.Y. Mestry

THE CATCH TREND OF THE COMMERCIAL TRAWL FISHERIES OFF RAMESWARAM*

Introduction

Fishery resources from the coastal waters off Rameswaram have been traditionally exploited by indigenous crafts and gears. Introduction of commercial trawling to tap the ground fishes and crustaceans along this coast has resulted in considerable expansion of the mechanised fisheries sector. The present account summarises the catch details of some of the commercially important fishes landed by the trawlers operating from Rameswaram (Verkottil) during the years 1980 and 1981.

Most of the trawlers are in the length of 30′ and 32′ with the horse power varying between 32.5 and 65 *(Mar. fish. Infor. Serv. T & E Ser. 11, 1979)*. Various fishing areas off Rameswaram covered by the trawlers are indicated in Fig.1.

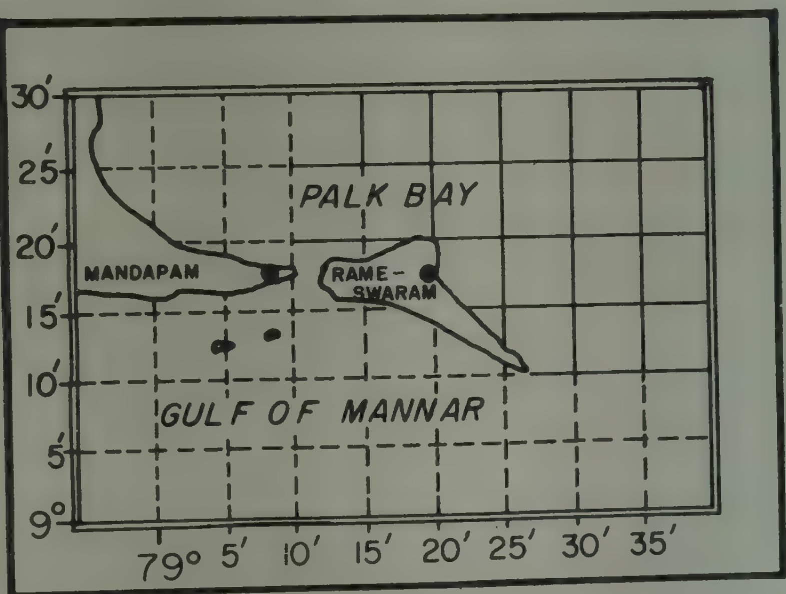


Fig. 1. Map indicating the various fishing areas off Rameswaram.

Monthly catch trend

Fig.2 represents the monthly catch trend and the estimated number of operations of units during the period. Maximum landings of 2,637 and 2,064 tonnes were recorded during June and July 1981 respectively; whereas in 1980 December and November landed more catch (1,837 and 1,632 tonnes respectively). As a whole, the year 1981 had recorded the maximum landings of 20,581 tonnes for an estimated 101449 number of operations of units showing an increase of about 43% and 38% in catch and in the number of operations of units respectively as compared to 1980. Similarly the catch per unit effort during 1981 also increased to 202.87 kg from 194.94 kg recorded in 1980.

Quarterwise catch composition

Table I shows the quarterwise catch trend and the percentage contribution of some of the important groups of fishes in the landings. The silverbellies represented by the genera *Leiognathus, Secutor* and *Gazza* formed the major group and contributed to about 52% and 50% of the total catch during 1980 and 1981 respectively; their catch increased from 7,474 tonnes in 1980 to 10,310 tonnes in 1981. Though maximum landings were noticed in the first quarter of both the years, good quantities were landed in the remaining quarters also. Elasmobranchs ranked second in the magnitude of the catch and formed about 16% and 17% of the catch during 1980 and 1981 respectively, the catch increasing from 2.370 tonnes in 1980 to 3,453 tonnes in 1981. While the third and fourth quarters of 1980 recorded higher landings, all the first three quarters of 1981 predominated in the landings of elasmobranchs.

Penaeid prawns mainly *Penaeus semisulcatus* and *Metapenaeus* spp. figured third in the landings; their share being about 10% of the total catch both in 1980 and 1981. The landings of prawns during 1980 showed an increasing trend from first quarter to fourth quarter. However in 1981 second and third quarters recorded higher landings. Sciaenids ranked next with 6% in 1980 and 10% in 1981. Their landings showed increasing trend from 103 tonnes in the first quarter to 371 tonnes in the fourth quarter. During 1981, all quarters registered more or less same catch trend.

Other groups in the landings viz., catfishes, red mullets, lizardfishes, flatfishes, crabs and cephalopods contributed to less than 10% of the total catch during the two years.

Table II gives monthwise landings of prawns and other groups with their percentage in the total monthly catches. The monthly percentage contribution of prawns to the total catch during 1980 ranged from 6.71 to 13.88 showing an increase in the total catch of prawns during 1981. In the case of other groups the percentage contribution during 1980 and 1981 ranged from 86.56 to 96.47 and 86.12 to 93.29 respectively.

*Prepared by P.K.Mahadevan Pillai, N.Jayabalan, M. Srinath and S. Subramani.

Table 1. *Quarterwise landings of trawlnets (in tonnes)at Rameswaram (Verkottil) and the percentage contribution of various groups (in parenthesis) during 1980 and 1981.*

Groups	1980					1981				
	I Q	II Q	III Q	IV Q	Total	I Q	II Q	III Q	IV Q	Total
1. Elasmobranchs	410 (13.03)	309 (10.41)	754 (20.43)	897 (19.61)	2370 (16.48)	888 (16.44)	1116 (19.39)	810 (16.79)	639 (14.00)	3453 (16.78)
2. Catfishes	30 (0.95)	39 (1.31)	77 (2.09)	33 (0.72)	179 (1.24)	18 (0.33)	27 (0.47)	2 (0.04)	32 (0.70)	79 (0.39)
3. Sciaenids	103 (3.27)	146 (4.92)	196 (5.31)	371 (8.11)	816 (5.68)	517 (9.52)	575 (9.99)	506 (10.49)	528 (11.54)	2126 (10.33)
4. Leiognathids	2046 (65.05)	1720 (57.95)	1680 (45.53)	2028 (44.34)	7474 (51.98)	3035 (55.86)	2631 (45.70)	2318 (48.05)	2326 (50.84)	10310 (50.08)
5. Red mullets	45 (1.43)	60 (2.02)	87 (2.35)	148 (3.24)	340 (2.36)	137 (2.52)	145 (2.51)	121 (2.30)	105 (2.30)	508 (2.47)
6. Lizard fishes	20 (0.64)	20 (0.67)	40 (1.08)	55 (1.20)	135 (0.94)	51 (0.94)	53 (0.92)	49 (1.02)	52 (1.14)	205 (1.00)
7. Flatfishes	35 (1.11)	28 (0.94)	43 (1.17)	30 (0.66)	136 (0.95)	30 (0.55)	44 (0.76)	47 (0.97)	48 (1.05)	169 (0.82)
8. Prawns	167 (5.31)	338 (11.39)	360 (9.76)	502 (10.98)	1367 (9.51)	382 (7.03)	730 (12.68)	570 (11.82)	419 (9.15)	2101 (10.20)
9. Crabs	40 (1.27)	76 (2.56)	146 (3.96)	139 (3.04)	401 (2.79)	105 (1.93)	203 (3.53)	172 (3.57)	160 (3.50)	640 (3.11)
10. Cephalopods	10 (0.30)	21 (0.71)	31 (0.84)	23 (0.60)	90 (0.63)	27 (0.50)	47 (0.82)	46 (0.95)	38 (0.83)	158 (0.77)
11. Others	240 (7.63)	211 (7.11)	276 (7.48)	343 (7.50)	1070 (7.48)	243 (4.47)	186 (3.23)	183 (3.79)	220 (4.82)	832 (4.04)
Total	3146	2968	3690	4574	14378	5433	5757	4824	4567	20581
Eatimated number of operations of units	16861	16374	22013	23510	73758	23316	26658	26398	25077	101449
Catch per unit effort (kg)					194.94					202.87

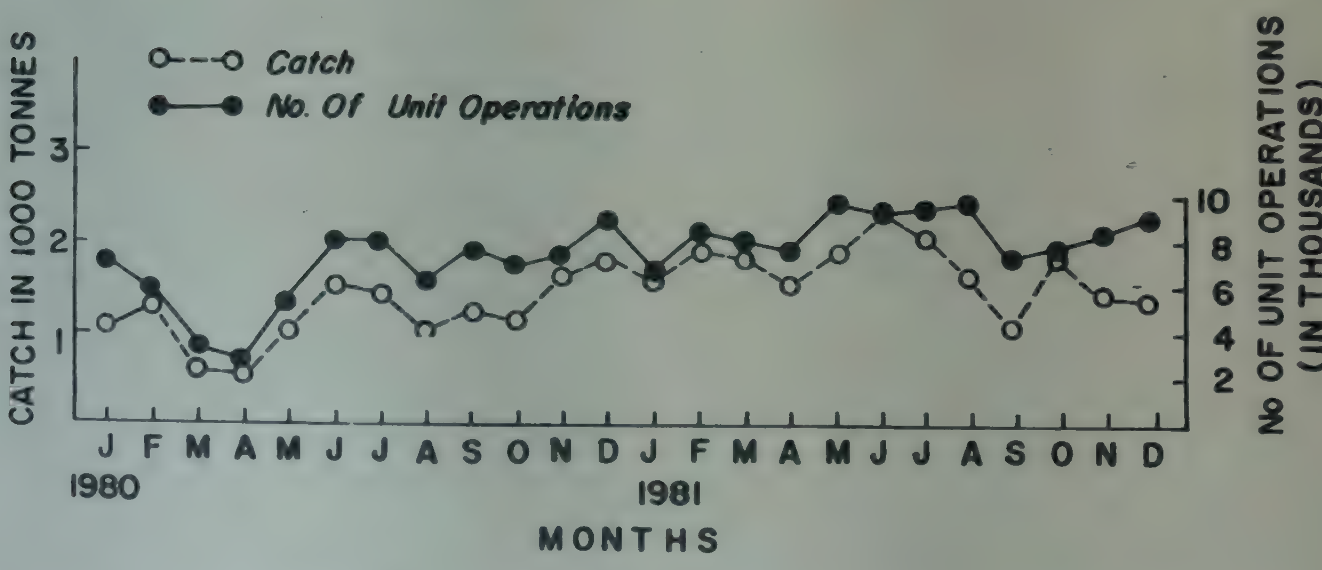


Fig. 2. Monthly catch trend and the number of unit operations during 1980–'81 at Rameswaram (Verkottil)

Table 2. *Monthwise landings of prawns and other groups (in tonnes) at Rameswaram (Verkottil) and their percentage contribution during 1980 and 1981.*

	Prawns		Other groups	
	Catch	Percentage	Catch	Percentage
1980				
January	90	8.23	1004	91.77
February	48	3.53	1312	96.47
March	29	4.19	663	95.81
April	31	6.31	460	93.69
May	105	10.78	869	89.22
June	202	13.44	1301	86.56
July	148	10.50	1261	89.50
August	87	8.67	916	91.33
September	125	9.78	1153	90.22
October	103	9.32	1002	90.68
November	163	10.00	1469	90.00
December	236	12.85	1601	87.15
Total	1367		13011	
1981				
January	121	7.31	1534	92.69
February	137	7.10	1793	92.90
March	124	6.71	1724	93.29
April	194	12.49	1359	87.51
May	255	13.88	1582	86.12
June	281	11.87	2086	88.13
July	235	11.39	1829	88.61
August	197	11.70	1487	88.30
September	138	12.83	938	87.17
October	133	7.19	1716	92.81
November	132	9.48	1259	90.52
December	154	11.55	1173	88.45
Total	2101		18480	

Remarks

The introduction of mechanised trawlers along the coast off Rameswaram had resulted in considerable expansion of traditional fisheries of silverbellies, while elasmobranchs, prawns and sciaenids form other important fisheries. The catch trend of the present study indicates the availability of silverbellies in large quantities throughout the year. As the operation of bottom trawl nets during the day time yields better catches of silverbellies, intensive day fishing will bring the required quantities of fishes as raw material to the fish meal plant located at Mandapam.

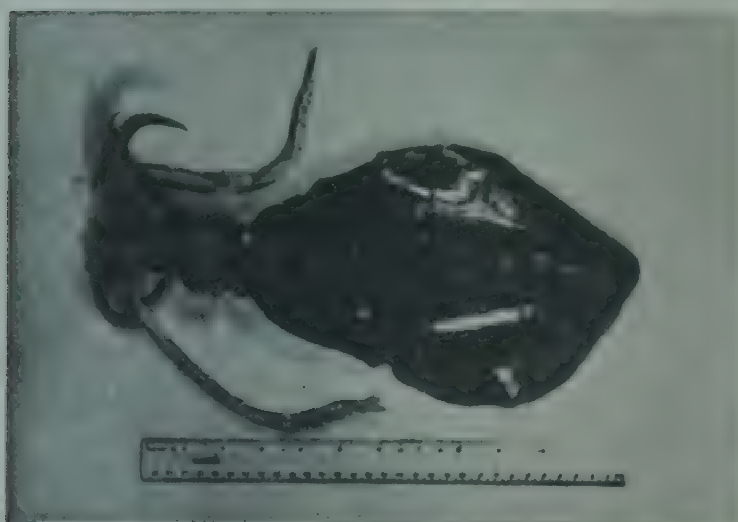
The study revealed that an increase of 38% in the number of unit operations in 1981 has resulted in an increase of 43% in the landings. The increase in the number of units in operation in 1981 is noticed in the first two quarters of the year and along with that substantial increase in catch also is recorded in these two quarters. The overall increase in catch per unit effort in 1981 is, however, marginal, rising from 194.9 kg to 202.9 kg. Since the increase in input of effort has resulted in a substantial increase in the catches along with increase in catch per unit effort, and the area of operations remaining more or less the same, it would appear that there is scope for further increased exploitation of resources available in this area, especially, silverbellies, elasmobranchs, prawns and sciaenids.

NEWS—INDIA AND OVERSEAS

Squid Sepioteuthis lessoniana recorded off Saurashtra Coast

Sepioteuthis lessoniana Lesson (Loliginidae, Cephalopoda) has been recorded off Saurashtra Coast of India for the first time. This species is widely distributed in the Indo Pacific, Red Sea, Arabian Sea and Bay of Bengal. In India it forms a seasonal fishery in the Palk Bay from February/March to June. The species has been recorded along the Malabar Coast. The present record is based on a specimen obtained on 17th March 1980 from the trawl landings at Veraval. It is a male measuring 266 mm dorsal mantle length and weighing 710 g (Fig.1 & 2)

Reported by H.Mohamed Kasim



Dorsal View

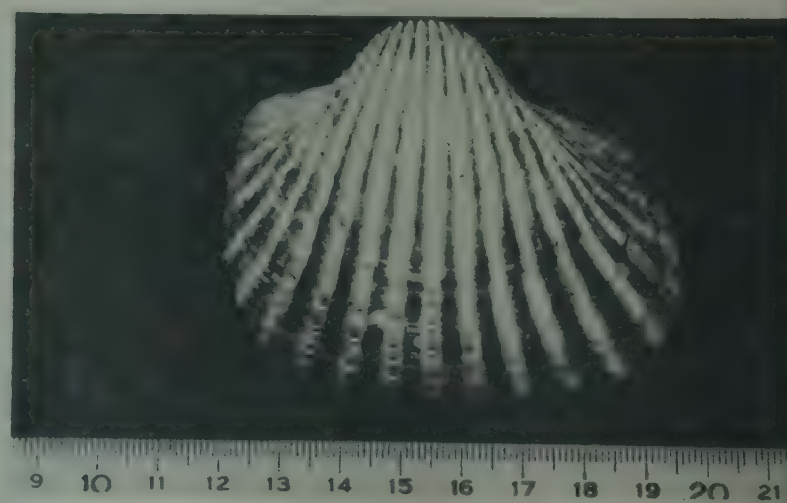
Ventral View

Trial export of blood clam to Japan

The Central Marine Fisheries Research Institute (CMFRI) assisted one of the sea-food exporting companies at Cochin in developing, for the first time, the export potential for the blood-clam *Anadara granosa* (Fig.1). The Japanese buyers have accepted the quality of the blood-clam meat from India. The resource information was provided to the entrepreneur who was also given a field trip to the clam beds by the Kakinada Research Centre of the Institute.

The blood-clam, also known as cockle in the South-east Asian countries, occurs in the Kakinada Bay and there is a regular fishery for the clams, with annual landings of about 1,000 tonnes. The meat is eaten locally only to a limited extent and exploitation is mainly for the shells used in production of lime. Therefore, finding an export market for the blood-clam meat will give a great economic advantage to the exploitation of this resource.

In view of its export potential, the CMFRI is immediately taking up a programme to assess the blood-clam resource of the Kakinada Bay (area 130 sq.km). Present exploitation is only from the shallow waters and the clam is not fished from the deeper waters. The survey would attempt to assess the potential and exploitable resource quantitatively from all regions of the bay.



Anadara granosa

Anadara granosa is traditionally cultured in Malaysia, Thailand, Vietnam and the Philippines. The CMFRI has conducted a series of experiments on culture of blood-calm in Kakinada Bay over the last three years and simple transplanation of seed in the shallow waters has given an yield of up to 2.6 tonnes/ 625 m^2 area/5½ months (for details please refer *Mar. Fish. Infor. Serv. T & E Ser.*, 23:7-9, September 1980). The blood-clam fishery at present is restricted to Kakinada Bay in India and the annual production is low. It would, therefore, be imperative to resort to culture of

this species if an export market for this clam has to be sustained.

Fin whale washed ashore in Rameswaram Island

Fin whale *Balaenoptera physalus* (Linnaeus) is the most numerous of all the whalebone whales. This whale is taken in greater numbers than any other species in the commercial whaling operations in the Atlantic Ocean. It is Ocenic and cosmopolitan in distribution, being found in Atlantic, Pacific, and Indian Oceans. This whale usually occurs in groups of 2 to 3 or more.

Fig. 1. Fin whale *Balaenoptera physalus* (Linnaeus) washed ashore at Akkamadam (Rameswaram Island) in a putrified condition.

Fig. 2. Fin whale *Balaenoptera physalus (Linnaeus)* being examined.

The stranding of young fin whale is quite rare. There were two earlier reports of the stranding of this species along the west coast of India, one from Bomaby (Kharbari *et al., J. mar. biol. Ass. India, 8* (1): 226-227, 1966) and another from Surat (Kharbari, *Indian J. Fish. 20* (2): 639-640, 1973). On 22nd January 1983 at about 0800 hrs the local fishermen at Akkamadam in Rameswaram Island noticed a young whale dead and washed ashore in a putrified condition.

The whale was found to be an young female measuring 9.90 m (Fig.1), estimated to be four years old and weighing about 5 tonnes. Most of the observed characters agree fully with the diagnostic characters of fin whale or common rorqual *Balaenoptera physalus*

The body colour of the fin whale was generally grayish black dorsally, white ventrally including tail flukes; left ramus grayish externally. The fore part of the head when viewed from the dorsal side was wedge shaped. Posterior middorsal region distinctly and acutely ridged; dorsal fin small, situated posterior to middle of body; major baleen plates 350-400, white and bluish grey in colour. The body measurements are given below:

Morphometric Characters	Measure-ments (cm)
Total length (tip of lower jaw to tip of caudal fluke)	990
Tip of lower jaw to origin of flipper	150
Breadth at the base of flipper	32
Height at the flipper	22
Length of the flipper (from the base to the tip of flipper)	60
Tip of lower jaw to origin of dorsal fin	520
Length of dorsal fin base	45
Height of the dorsal fin	15
Tip of lower jaw to origin of genital region	460
Tip of lower jaw to origin of anus	510
Breadth of head	96
Body depth at the origin of flipper	480
Length of lower jaw	276
Body depth at the origin of anus	120
Tip of lower jaw to origin of the eye	184
Height of the body	258
Estimated weight	5 tonnes

Reported by P.Nammalwar, S.Krishna Pillai and S.Sankaralingam

Noise pollution affects shrimps

Two French scientists Michele Regnault and Jean-Paul Lagardere working at CNRS Laboratory, Biological Station, Roscoff, France have reported their findings which indicate that the European commercially important shrimp *Crangon crangon (L)* is affected by the level of the ambient noise expressed as sound pressure. Preliminary studies in this field have proved that high sound level causes in this particular shrimp some modifications in behaviour like increased cannibalism and also growth delay. Noticeable physiological changes were observed in oxygen consumption and ammonia excretion rate, indicating the metabolic response of the animal to changes in noise level.

Marine Ecology 11, February 1983

PROVEN TECHNOLOGY

5. TECHNOLOGY OF EDIBLE OYSTER CULTURE*

Highlights: Oysters are cultured by the Central Marine Fisheries Research Institute at Tuticorin by rack and tray method. The spat of the edible oyster *Crassostrea madrasensis* are collected using lime-coated :semi-cylindricall country tiles and other suitable spat collectors and when the spat grow to a size of about 25 mm, they are scraped, reared in cages and, after a period of further growth, grown in trays kept over racks erected in coastal waters. The oyster reaches a harvestable size of 80-90 mm, weighing 100-120 g shell-on, in about a year. Regular shaped oysters are produced in the farm by this method.

Operational details: The site for oyster farm is selected based on the following criteria: The area must be protected by nature against violent wind and wave action and a natural population of oysters must be present nearby in sufficient numbers to ensure adequate spatfall. There should be tidal flow and salinity range must be between 25 ppt and 37 ppt. The water must contain abundant phytoplankton suitable as food for oysters and larvae.

Fig. 1. Edible oyster farm of CMFRI at Tuticorin showing the rack -and-tray method of culture.

The oyster spawns during two seasons, namely March-April and August-September in Tuticorin area. After a free swimming life of about three weeks, the larvae settle on a hard substratum and become spat. Oyster spat are collected on a large scale using lime - coated tiles. The tiles are given double coating of lime and sand, dried in shade and are kept in trays placed over racks set up in the neighbourhood of breeding oysters during the spawning season in shallow coastal waters, bays or creeks. Spat are also collected on other materials such as oyster shells strung on rope and asbestos sheets. On the spat growing to a size of 25 to 30 mm they are removed from the spat collectors using a chisel and reared in cages of 40 × 40 × 10 cm size, stocking at a density of 300-350 spat per cage. After two or three months, the oysterlings are trnsferred to rectangular trays of 90 × 60 × 15 cm for further growth. About 250 oysterlings are put in each tray and the trays are kept tied on racks erected in interdidal zone. Each rack measures 24 × 12.5 m and is constructed by fixing six teakwood or casuarina poles 2.5 m in height in two rows 2 m apart. The two rows of vertical poles are connected by horizontal poles and a platform-like structure is provided for the culture trays to be kept. Farm maintenance is carried out regularly and pests and predators are eliminated. The oysters grow fast and attain average size of 80-90 mm weighing 100-120 g with meat forming 8-10% at the end of the year. The harvested oysters are purified with filtered sea water treated earlier with chlorine in 3 ppm strength.

Production: From the culture operations in a three year period in 0.25 ha area the estimated production of oyster would be 125 tonnes with a meat yield of 10 tonnes. At the end of each year approximately 42 tonnes of oyster could be harvested. Apart from the meat, the oyster shells fetch a substantial return as by-product since they are used in the manufacture of calcium carbide and cement.

Fig.2. Depuration of oysters.

Inventory and cost: The materials involved in oyster culture such as racks, dinghy, iron cages, trays and other farm accessories can be used for three

years. For a three year project the expenditure would be as follows: capital cost of materials Rs.96,000, contingent expenses for seed collection Rs.10,000 and wages Rs.35,000. Total estimated cost would be Rs.1,41,000. The estimated cost of production determined based on current cost of materials is Rs.15/- per kg of oyster meat.

Prospects: There are good prospects for culturing edible oyster *Crassostrea madrasensis* adopting the method described above in the large stretches of shallow coastal waters, creeks, and bays. The high rate of spatfall, the fast growth of oysters and its nutritional value makes *C.madrasensis* an ideal species for farming which could step up production substantially. The Sonapore backwaters, Pulicat lake, Killai backwaters, Tuticorin bay, Punnakayal estuary, some of the backwaters in Kerala and low lying areas adjoining some of the estuaries of Karnataka are suitable for oyster culture. The edible oyster has at present a limited domestic market potential in metropolitan cities and this should be enlarged. Processed oyster meat has an export potential.

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*Prepared by Molluscan Fisheries Division

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BOOKS

Estuarine comparisons Ed. by Victor S. Kennedy, Academic Press, New York, pp 709, 1982

This is the proceedings of the sixth biennial Conference of the Estuarine Research Federation held at Gleneden Beach, Oregon during Nov. 1981. The book includes reviews of published literature and presentation of new information. In the first section, a number of comparisons of different kinds are made among estuaries after attention has been drawn to problems with the making of measurements on which such comparisons are based. The second section includes review papers on aspects of the diverse interactions that occur on or in marsh soils, coupled with new and complementary information derived from recent studies. The matter of retention of invertebrate larvae in seaward draining estuaries is examined in another section; insights from physical oceanograpy, behavioral experiments, field sampling, and genetic studies are brought to bear on the problem. The final section draws attention to the Chang Jang estuary in China, juxtaposing historical data spanning two millenea with recent knowledge derived from use of space satellites.

Aquatic oligochaeta of the USSR by O.V. Chekanovskaya, Amerind Publishing Co., New Delhi. pp 513, 1981.

Oligochaete worms are found in every type of continental water (fresh and saline). Some are habitual dwellers of the littoral zone and partially of the sublittoral zone in seas. Many river and lake biotopes are often dominated by oligochaetes, which constitute a considerable percentage of the benthic fauna. They may comprise 50 to 80% and even 100% of the benthic biomass. This fact has captured the attention of research workers throughout the world. Oligochaete worms dwelling in the profoundal zone of lakes play an important role in the exchange of matter in a reservoir and are responsible to a notable degree for the rate of mud formation and mineralization of bottom sediments. The preserve of a large population of saprophytic species of oligochaetes is an important factor in the self-purification of polluted waters. Studies have also shown the importance of oligochaete worms in the nutrition of some commercially important fish. These facts indicate the major place held by oligochaetes in maintaining the natural cycle and in augmenting the national economy.

The English translation (by Mrs. Indira Kohli) of the Russian book includes a rather detailed introduction to the morphology of the oligochaetes. Information on the physiology of aquatic oligochaetes has been provided in most of the cases. Information of the ecology and occurrence of the species had been taken primarily from reports which refer to the water reservoirs of the USSR.

Aquarium systems Ed. by A.D. Hawkins, Academic Press Inc. London pp 452, 1982.

This is a practical guide to fish-keeping in the laboratory and is the result of collaboration among working scientists with first hand experience to specific subjects.

Among the many problems to be overcome in working with live fish for laboratory experiments, collecting and keeping them in a healthy state suitable for experimental study is the most important and involves problems in handling, transferring from tank to tank, anaesthetization and treating in various ways. The volume considers the basic aspects of aquarium design and construction, the supply of aquarium water and its treatment to make it suitable for fish, water quality management and other practical aspects of fish husbandry. Problems of handling of fish, their capture and transport and their health and well being in captivity are also dealt with in different sections.

Compiled and prepared by M.J. George, G. Subbaraju and S.K. Dharmaraja.
Published by Dr. M.J. George, Senior Scientist on behalf of the Director, Central Marine Fisheries Research Institute, Cochin-682 018. Phototypeset and printed at PAICO, Cochin 31.

MARINE FISHERIES INFORMATION SERVICE

No. 49

APRIL - MAY 1983

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Abbreviation — *Mar. Fish. Infor. Serv. T & E Ser.*, No. 49 : 1983.

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Cover Photo: Chank bored by sponge

CALCIBIOCAVITOLOGICAL INVESTIGATIONS

P.A. Thomas, K.K. Appukuttan, K. Ramadoss and S.G. Vincent

1.Introduction

Several species of marine organisms are known to excavate cavities inside hard calcareous objects like shell, coral, lime stone etc. either by chemical or mechanical means or by a combination of both. Representatives of about 12 major taxa of marine algae and invertebrate animals are known to engage themselves in such destructive activities in the marine environment. A lot of information has already been amassed in the past century on the systematics, distribution, ecology and physiology of these organisms from different parts of the world. The biological, chemical and geological changes that these organisms would bring about in the marine environment are, by no way, insignificant as they cause bioerosion, influence calcium balance in the sea, and control the structure of calcium carbonate - producing communities.

Animals which excavate hard calcareous objects by mechanical means often remove the hard particles from the latter in chips or in any other form that is characteristic to the species, and such particles often form a sizable fraction of the sediment adjoining the respective environment. Boring sponges, which chip out minute calcium carbonate particles of more or less uniform size and shape by a combination of enzymatic and physical action, expel them through the oscula. Such particles often contribute about 2-30% of the total sediment load in the reef environment. These sponges, while removing such chips from the substratum, only 2-3% goes in dissolved form. It is estimated by earlier workers that in reef environment with high sponge concentration, the erosion rate may go up to 3 kg m^{-2} $year^{-1}$ or 1 mm per year. On the other hand, animals which resort to burrowing by chemeical means often dissolve calcium carbonate matter which may mix with sea water and this will, to a certain extent, alter the calcium balance in the environment.

Calcium carbonate penetration by marine organisms (calcibiocavitation) is a major poroblem in the marine environment. In areas where corals and economically important molluscan beds occur, precise information on the number of such deleterious species and the magnitude of damage caused by them to the calcium secreting animals are prerequisites for an efficient management of both natural and tended stocks. With this end in view, a detailed study on these aspects has been undertaken during the years 1980-'82, and the salient findings which emerged are presented here.

Gregarious molluscs such as the sacred chank *Xancus pyrum* (Lam.), mussels (both green and brown), rock oysters *(Crassostrea spp.)*, pearl oysters, *Thais rudolphi* (Lam.) and corals which inhabit the southwest coast of Kerala and the Gulf of Mannar have been investigated in detail for the various animals which destroy them by boring into their hard parts. It is found from the investigations that the major groups of animals which destroy them are 1) sponges, 2) molluscs, 3) polychaetes, and 4) sipunculids. When the sponge bores into a live molluscan shell the latter may exhibit both physical and physiological strain and this may result in a variety of pathological manifestations. A detailed account on 12 well recognised diseases which occur in molluscs due to the infection of sponges has been published by Thomas (1980, *Symp. Coastal Aquaculture, Mar. biol. ass. India)*

The various groups of boring organisms are dealt with below:

2. Sponges

2.1 As pests of Chanks (Figs. 4B, 5A, B, C)

2.1.1. Incidence of boring sponges

Every year a sizable fraction of the chanks exploited at each centre along the Indian coast is being discarded as 'wormed'. Detailed study made by Thomas (1979, *Indian J.Fish. 26, 1 & 2)* revealed that all such 'wormed' shells are bored by sponges and the percentage of worm attack on them is practically nil.

Examination of the data published elsewhere *(Bull.* C.M.F.R.I. No.25) shows that the incidence (infection per 100 shells collected at random) during the years 1961-1967 at Tuticorin fluctuated between 1.5 and 20.9 and this percentage, when compared with that seen in the beds off Sivaganga, Ramanathapuram, Tanjavoor and Kanyakumari, is very low. The rates of incidence noted at Tuticorin beds during the seasons 1980-'81 and 1981-'82 were 10.9 and 8 percent respectively (Fig.1A)

The chank beds off Thiruchendur are only occasionally fished as compared to those off Tuticorin; and

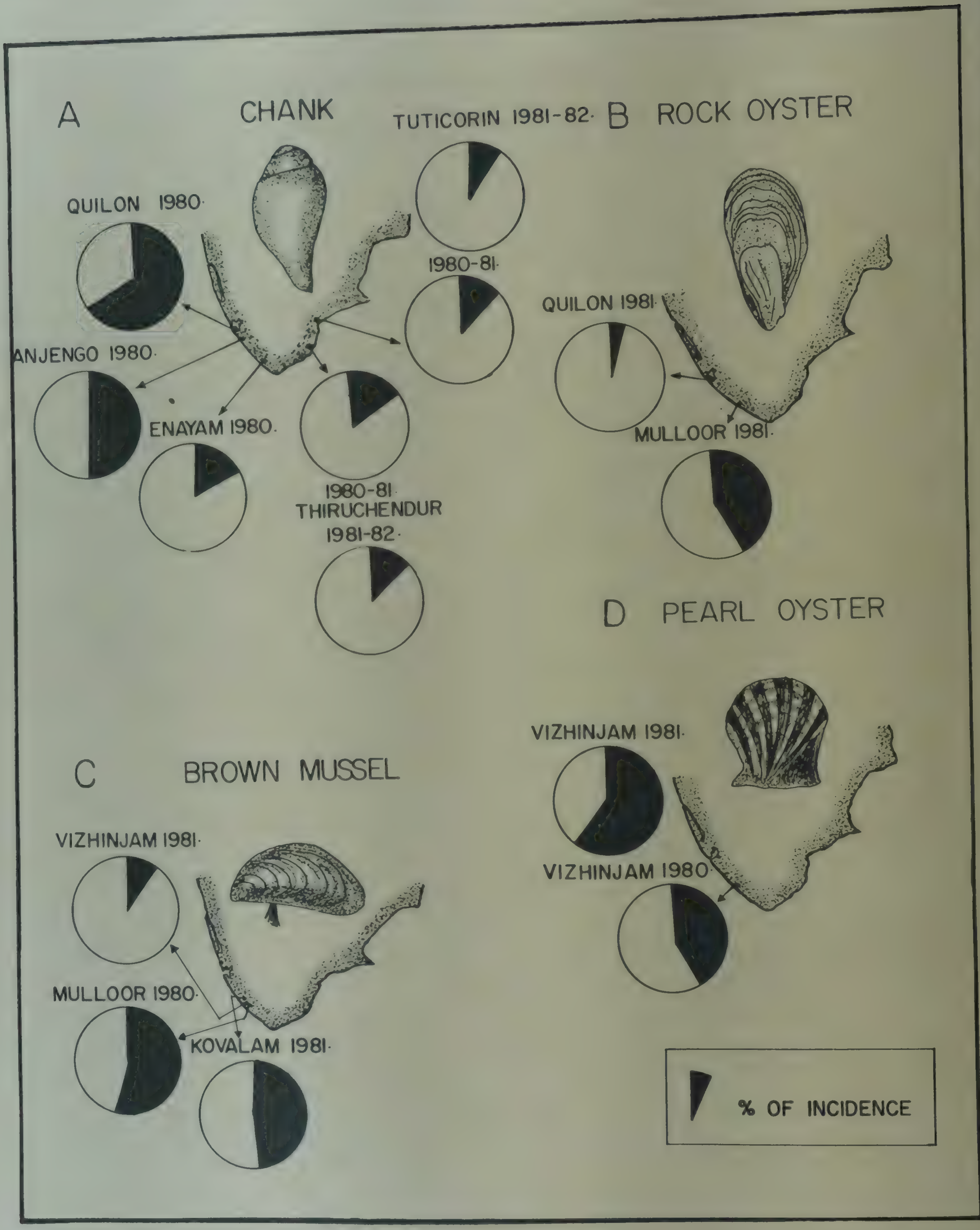

Fig. 1. A-D Percentage of incidence of boring sponges in chanks, mussels and oysters at different places.

recently when the fishing resumed in 1980-'81 season, the incidence was found to be quite high (17%). But during the ensuing season, i.e. 1981-'82, the incidence came down to 12.2% (Fig.1A).

The rate of incidence varied considerably from 'paar' to 'paar' as also from year to year. During 1980-'81 season, at Tuticorin, the maximum incidence of boring sponges was noted at Meleonbothu paar (30.57%) and the minimum at Siluvai paar (6.9%). A more or less similar pattern was noted at Thiruchendur beds also with the maximum at Thiruchendur Karai paar (34.2%) and the minimum at Karuwal paar (18.77%).

Investigations on the chank beds off the southwest coast of Kerala revealed a low incidence (10.15%) at the southern centre (Enayam), whereas the same increased abruptly towards the northern centres like Anjengo and Quilon. During 1980, the incidence recorded at Quilon was about 60% and at Anjengo, 50% (Fig.1A).

2.1.2. Species of boring sponges

Species of boring sponges which infect the chank shells, in the order of abundance, were *1) Cliona celata* Grant, *2), C.vastifica,* Hancock, *3) C.carpenteri* Hancock and *4) C.lobata* Hancock. An earlier study made by Thomas (1979, op. cit) revealed only the first three species in the chank beds of the Gulf of Mannar, and hence *C.lobata* may be considered to be the most recent intruder into the chank beds of the Gulf of Mannar.

2.1.3. Abundance and population structure

C.celata formed the most dominant pest of chanks in the Gulf of Mannar up to 1981. But subsequently, ie. in 1981-'82 season, this composition changed and *C.vastifica,* which had only a secondary role in the chank beds till 1981, dominated. Hence 1981-'82 season may be considered to be a transitional period when the dominance shifted from an established species *(C.celata)* to a less important one *(C.vastifica)* (Fig.2A)

Another important finding emerged during the present study is the infiltration of *C.lobata,* a dreadful pest of rock oysters of the Atlántic, into the Indian chank beds. Untill 1980-'81 season there were only three species of boring sponges in the chank beds of the Gulf of Mannar, and the presence of *C.lobata,* the 4th species, may pose a serious threat to the economically important molluscs of the Gulf of Mannar as a whole. At present this species is confined to the chank beds of Thiruchendur alone, but it is likely to spread throughout the Gulf of Mannar (for further details on the infiltration of this species into various other species of molluscs, refer the section 2.2.2)

In the chank beds extending along the southwest coast of Kerala the dominance of *C.vastifica* is noted only in the southern centre (Enayam) and here it practically co-exists with *C.carpenteri.* But towards the northern part of this zone its positition has been taken up by *C.celata.* In the chank beds off Vizhinjam, *C.celata* dominated (67%) among boring sponges during 1981, followed by *C.celeta* (33%). But in the northern centres like Anjengo and Quilon only *C.celeta* was noted. But this monospecific dominance of *C.celata* in the Quilon beds did not last long, and chanks collected during the next season, ie. 1980-'81, included *C.vastifica* in stray numbers (13.4% of the population). During the subsequent season, ie. 1981-'82, though *C.celata* still constituted the major component among the boring sponges, *C.vastifica* disappeared totally from the bed, and its place has been taken up by by *C.lobata,* a species unknown in the chank beds off the southwest coast of India till 1980-'81, constituting about 20% of the boring sponge population (Fig.2A).

The present infiltration of *C.lobata* into the chank beds of the southwest coast of Kerala is the first major attempt in colonishing the chank beds of this area. The infiltration period of this species into the Quilon chank beds exactly coincides with the infiltration of *C.lobata* into the chank beds of Thiruchendur during 1981-'82 season.

C.carpenteri, which is found wide spread in the chank beds off Tuticorin and Thiruchendur, is met with only in the southern centre (Enayam) and is totally absent from the northern centres.

2.2. As pests of pearl oysters (Figs. 4C, D, 5D)

2.2.1. Incidence of boring sponges

It was not possible to examine the pearl oysters from the natural beds of Tuticorin during the present investigation. The first report on sponges as the major enemy of the pearl oyster of Ceylon beds is that of Herdman (1905, *Rep. Pearl oyster. Fish.*) who had reported an incidence as high as 80% at the Cheval paar, Ceylon. Th only species reported by him was *C.margaritifera,* a new species. Subsequently Thomas (1979, op. cit.), based on study during the years 1969 and 1970, reported two species, *C.vastifica* and *C.celata* and the percentage of incidence reported by him was 8.5 in the natural beds of the Gulf of Mannar. No specimens of *C.margaritifera* were available in the Gulf of Mannar at that time.

Experiments on pearl culture were taken up at Veppalodai, near Tuticorin in 1972 and at Vizhinjam in

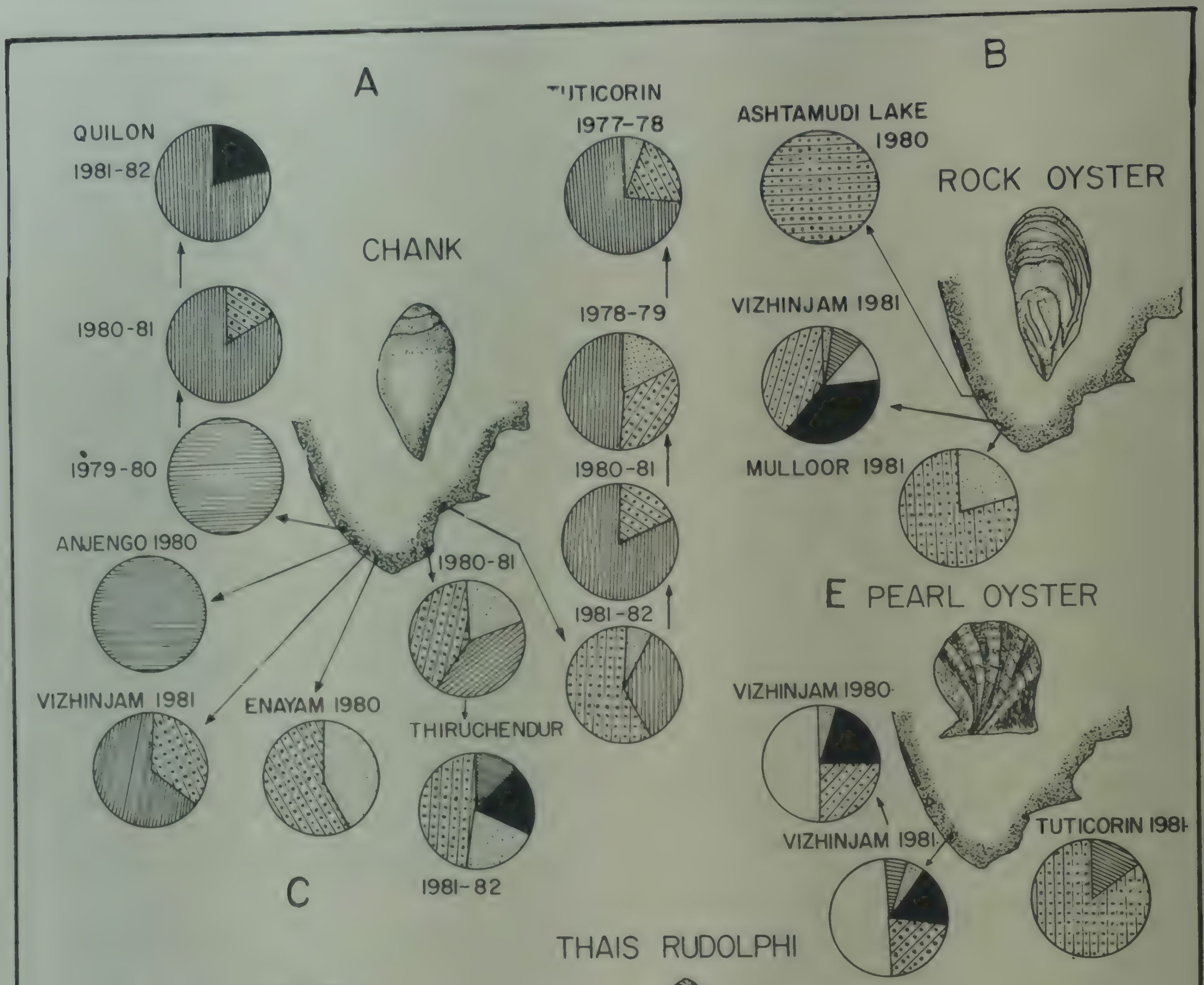

Fig. 2. A-E Abundance of different boring sponge species in chanks, mussels and oysters at different places.

1975. As a part of the investigations on the fouling and boring organisms that occur on culture rafts, Alagarswami and Chellam (1976, *Indian J. Fish., 23 (1 & 2)* made a preliminary study and reported polychaetes, sponges,molluscs and isopods to be the major pests on the culture rafts at Veppalodai, Tuticorin. They could record only one species of sponge *(C.celata)* from the cultured pearl oysters; and this made the oyster susceptible to further damages by polychaete and other infections. The rate of infection by *C.celata*, according to the above workers, was 20%. Subsequent studies made by Thomas (unpublished data) on farm grown pearl oysters from Tuticorin during 1978 revealed the presence of only *C.vastifica* at Tuticorin. Specimens of *C.vastifica* examined during February (1978) harboured as many as 5 gemmules per chamber indicating a very high rate of autoinfection in the culture system. During 1981, another collection of cultured pearl oysters was made from Tuticorin, and the same revealed the existance of two species, *C.vastifica* and *C.celata* (Fig.2 F). The former constituted the major pest while the incidence of the latter was rather negligible (12%).

The infection pattern of boring sponges on the cultured pearl oysters at Vizhinjam presents an altogether different picture. The incidence was found to be high at Vizhinjam when compared to that at Tuticorin: 41% of the cultured pearl oysters was found infected during 1980, whereas the same went up to 80% during 1981 (Fig.1D).

In order to study whether the pearl oyster or the flat oyster is more prone to sponge infection, analyses were made separately for these two species. These studies revealed that *P.fucata* (pearl oyster) is more vulnerable than the flat oyster and the incidence was found to be 47 and 37 respectively. Size frequency analyses also revealed that the infection rate, in *P.fucata*, increased abruptly in higher size groups unlike in flat oysters. Size frequency (%) distribution of the total population of cultured pearl oyster and flat oyster together with the same of infected shells and those with openings inside the shell are furnished in Fig. 3,D,E and F.

2.2.2. Species of boring sponges.

Five species of boring sponges were found to infest the cultured pearl oysters at Vizhinjam, and they are, in the order of abundance, 1) *Cliona margaritifera* Dendy, 2) *C.vastifica* Hancock, 3) *C.lobata* Hancock, 4) *C.carpenteri* Hancock, and *C.celata* Grant. Cultured pearl oysters at Tuticorin were found infected with two species, viz. *C.vastifica* Hancock and *C.celata* Grant (Fig. 2E).

It may be mentioned in this context that *C. margaritifera* was first reported from Ceylon (Dendy, 1905, *Rep. Ceylon Pearl Oyster. Fish.*, Suppl. 18.) based on a collection made by Herdman from the pearl banks of Ceylon, in 1902. It is reported by Dendy that this sponge spread in the pearl banks almost like an epidemic and destroyed the pearl oyster beds either partly or completely. No other species of *Cliona* were reported by Dendy in his above cited report. There is sufficient ground to believe that *C.margaritifera* totally disappeared from the Ceylon beds after this great epidemic. Subsequent collections made from the Gulf of Mannar and other parts of the Indian seas in general also failed to record this species, though a few atypical or aberrent forms have been reported from widely separated areas and also from hosts other than pearl oyster. The reappearance of this highly destructive species on raft cultured pearl oysters at Vizhinjam, in 1980, hence is very interesting as it forms a major infiltration into the pearl oysters of India after a long lapse of about 80 years. Since 1980, the incidence of this species has generally been on the increase, and now a sizable fraction of the boring sponge population among the gregarious molluscs off Vizhinjam is composed of this species.

Similarly, *C.lobata* recorded from the cultured pearl oysters at Vizhinjam in 1980, also deserves mention in this context. This is a very common and wide spread oyster pest of the Atlantic and the first record of the same from the Indian seas is that of Burton (1937, *Bull. Madras Govt Mus., 1* (2) Pt. 4) from Pamban pas (Gulf of Mannar). But subsequent surveys failed to record this species from the Indian seas. The occurrence of *C.lobata* on cultured pearl oysters in alarmingly large numbers in 1980 (Fig. 2E) hence, pose a serious threat to the comercially important molluscan beds of Indian waters as a whole. As in the case of *C.margaritifera* mentioned above, the impact of this species is felt among all gregarious molluscs inhabiting the southwest coast of Kerala; and forms the major pest of mussel, rock oyster, and *Thais rudolphi* collected off Vizhinjam in 1982. The chanks collected from Thiruchendur beds during 1981-'82 indicate the infiltration of this species into the chank beds of the Gulf of Mannar (Fig. 2A)

2.2.3. Damage caused to the shell

When the sponge ramify the inner layers of the pearl oyster shell, it is likely to produce holes on the nacreous layer (Thomas, 1979, op. cit.), through which the sponge comes into contact with the soft parts of the animal producing lysis of the epithelial lining of the mantel. When the animal is in its actively growing phase such openings made by sponges are mended

quickly by secreting nacreous substance over these openings. Such repairs, no doubt, may cause considerable physiological strain on the host. But this situation may get still aggravated when the mollusc becomes weak due to old age or other environmental stress; and at this stage the openings formed in the inner side of the shell remain permanently open. At Vizhinjam, during 1980, pearl oyster shells above 50 mm (height) often possessed such openings inside the shell. Among infected shells, 23% of *P.fucata* and 15% of the flat oysters were in this condition. A steep increase in the number of such shells was noted during the ensuing year (1981) when about 27% of the infected shells possessed openings in the inner side. It is actually not known to what extent the energy utilised in repairing such holes will affect the pearl-producing capacity of the pearl oyster.

In conclusion, it may be stated from the past observations that the boring sponges can cause mass mortality (Herdman, 1905 op. cit.), physiological strain (Alagarswamy and Chellam, 1976, op. cit.), and suppression of growth (Chellam, 1978, *Indian J. Fish.*, 25, (1 & 2) to pearl oysters of both natural and cultured stocks.

2.3 As pests of Mussels

2.3.1 Incidence of boring sponges

Mussels, both brown and green, occurring in fishable magnitude along certain areas of the south-west of Kerala as well as the brown mussels being cultivated at Vizhinjam were investigated in detail during the period 1980-'82 for boring sponges. Collections were made from the intensely fished shallow waters and also from the occasionally fished deeper beds to know the effect of fishing on the population structure and composition of the various boring communities. The maximum size of mussel from occasionally fished beds was considerably larger as against those in the intensely fished beds.

The incidence of boring sponges was found to be rather high in occasionally fished deeper beds. Collections made off Mulloor in 1980 (at 15 m. depth) recorded about 54% incidence for brown mussels and 50% for green mussels. A more or less similar figure (48%) was obtained in the case of brown mussel collected from the deeper parts of Kovalam also. Well fished beds off Vizhinjam, on the contrary, registered very low incidence (10.6%) during 1981 (Fig.1C).

2.3.2. Species of boring sponges

The following five species, in the order of abundance, were found to infest the mussels off the south west coast of Kerala during the period 1980--82: 1) *Cliona lobata* Hancock, 2) *C.vastifica* Hancock, 3) *C.margaritifera*, 4) *C.carpenteri* Hancock and 5) *C.celata* Grant.

2.3.3. Abundance and population structure

As in the case of cultured pearl oysters at Vizhinjam, the impact of the two new migrants viz. *C.margaritifera* and *C.lobata* was well seen among the mussel population also from 1980 onwards. *C.lobata* constituted the major pest in the deep water beds off Mulloor and Kovalam alike (Fig.2C), but *C.vastifica* formed the major pest in the shallow water areas off Vizhinjam. *C.margaritifera* was found to be the second largest component both in deeper as well as in shallow water beds. It is noted generally that the sponge infection starts at 60-64 mm size group onwards in green mussels. Infection by *C.celata* was rather negligible and occurred at the shallow water beds off Vizhinjam. Size frequency (%) distribution of the mussel samples analysed from different beds together with the same of infected shells in the population are presented in Fig. 3 A,B,C.

The infection of sponges was found to be nil among the farm cultured brown mussels at Vizhinjam. The reason is that the mussels are kept on rafts only for a short period (5 months on an average) and are harvested as they attain a size of 70-80 mm. In the natural condition also the infection rate is quite negligible in smaller size groups.

2.3.4. Damage caused to the shell

As in the case of pearl oysters, here also the borings are confined to the thickest parts of the shell. But in the case of those infected by *C.margaritifera* and *C.lobata*, the ramifications of the sponge, in advanced stages, may reach up to the margin of the shell. As in pearl oysters here also the tendency to pierce the inner part of the shell by the sponge was rather well pronounced, but unlike in pearl oysters no attempt by the mussel to repair these openings by nacreous material was observed. Blister formation was rarely noted among mussels.

2.4 As pests of rock-oysters (Fig. 4A).

Rock oysters *(Crassostrea* spp.) are abundantly distributed in the intertidal realms of the sea and the estuaries of the south west coast of Kerala. Specimens of rock oysters were examined from the shallow areas (0-2 m depth) off Vizhinjam, moderately deeper areas (10-15 m depth) off Mulloor, and also from the estuarine areas (Ashtamudi Lake, Quilon) for the incidence of boring sponges.

2.4.1. Incidence of boring sponges

There are no data on the overall incidence of boring sponges in the rock oyster population from the

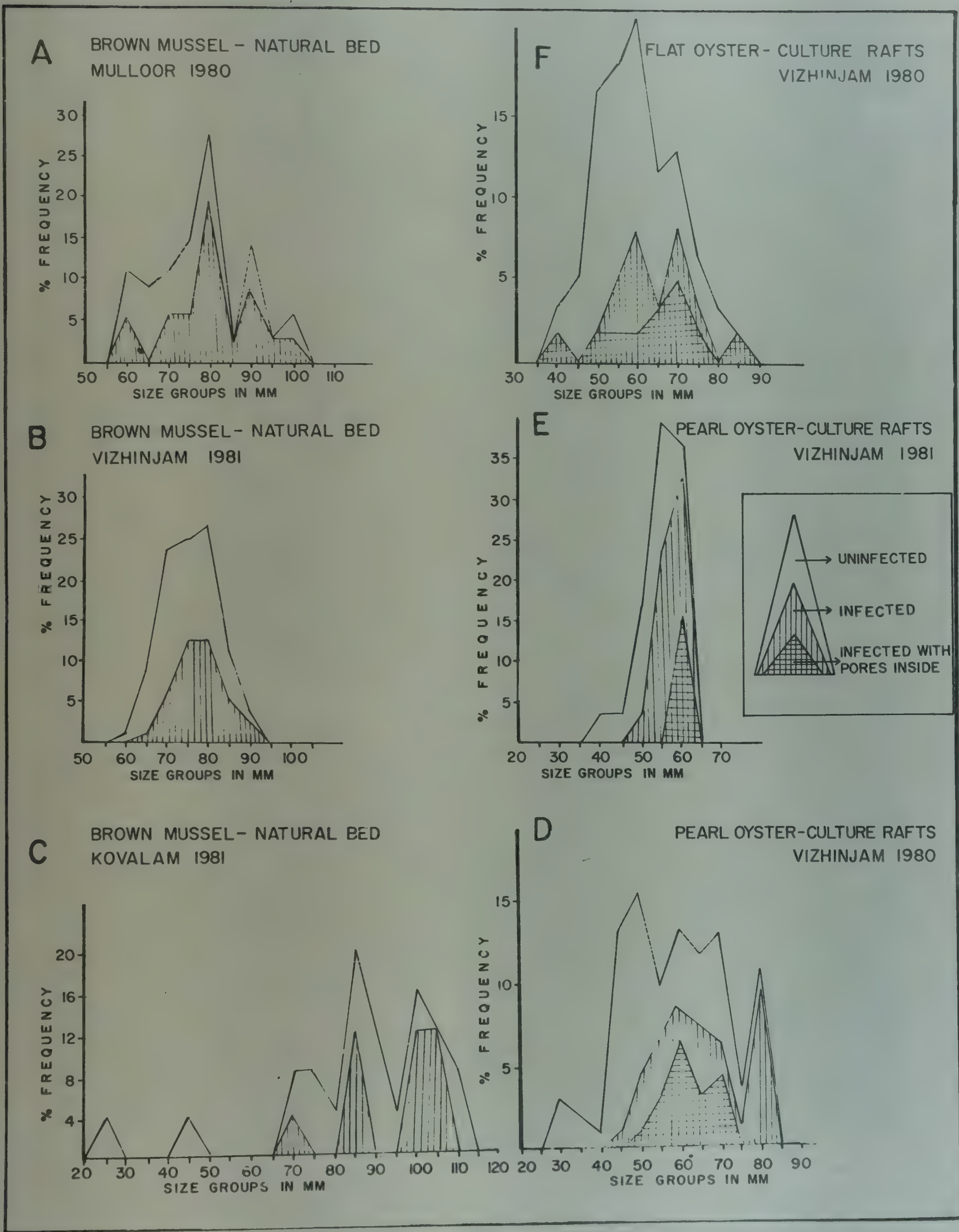

Fig. 3. A-F Percentage of infection by boring sponges in brown mussels in natural beds and in oysters in culture rafts.

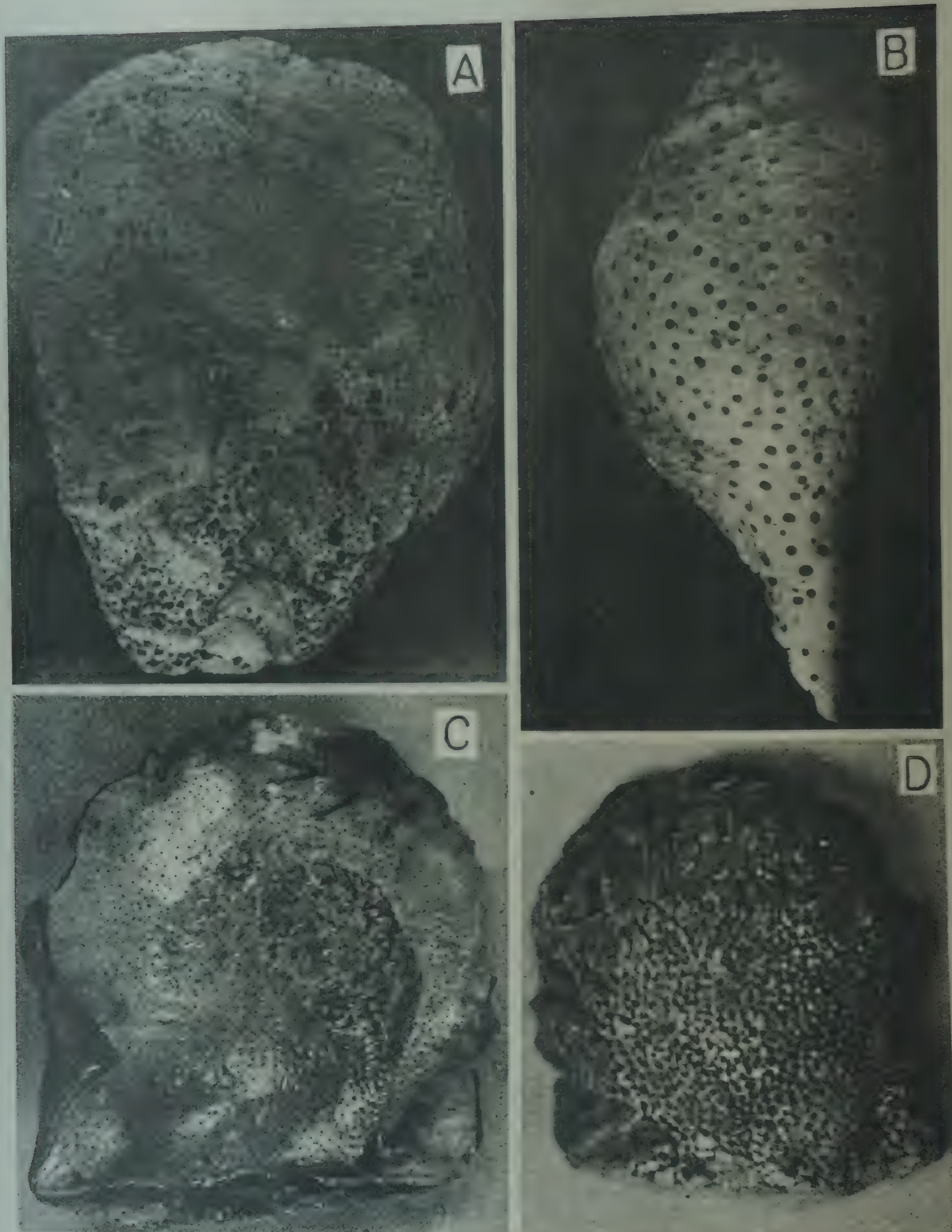

FIG. 4

A. *Crassostrea* sp. bored by sponge

B. *Xancus pyrum* bored by sponge.

C. Pearl oyster shell (inner view) bored by sponge. The adductor attachment zone is eroded much and the pores made by sponge in the inner part of the shell are also clearly visible.

D. Badly damaged pearl oyster shell (outer view).

shallow areas off Vizhinjam, but the data obtained from the moderately deeper areas off Mulloor (Fig. 1B) show that the incidence was rather high in these areas (41.6%). The estuarine areas investigated registered very low incidence (8%).

2.4.2. Species of boring sponges

Rock oysters of this area were found infected with five species of boring sponges. The various species, in the order of abundance, were: 1) *Cliona vastifica* Hancock, 2) *C.lobata* Hancock, 3) *C.carpenteri* Hancock, 4) *C.margaritifera* Dendy and *C.celata* Grant.

2.4.3. Abundance and population structure

The shallow areas off Vizhinjam exhibited rather a complex species composition (5 species) as against the deeper areas where it consisted only of 2 species (Fig. 2B). But this composition changes abruptly in the estuarine condition as there is much fluctuation in the salt content from time to time. The only species capable of tolerating wide fluctuations in salinity is *C.vastifica,* and hence this species enjoys a wider distribution in the Ashtamudi Lake.

The major pest of rock oyster in both shallow and moderately deeper areas was *C.vastifica* though its abundance varies from place to place (Fig.2B). In shallow areas off Vizhinjam *C.vastifica* accounted for about 40% of the population while in deeper areas off Mulloor it was about 80%. A similar pattern of abundance was noted in the case of *C.carpenteri* also; in deeper areas it was five times as abundant as in shallower areas. Species like *C.lobata, C.margaritifera,* and *C.celata* were commonly met with in the shallow water beds only.

2.4.4. Damage caused to the shell

It is generally noted that the attached valve is infected first and thence the infection spreads to the free valve by contact. In all cases, the sponge comes into contact with the soft parts of the mollusc and possibly no effort is taken by the latter to repair these openings made by sponge. Normally when such pores are distributed densely in localised areas on the inner side of the shell such areas present an undulated appearance. Damage to hinge area of the shell as well as to adductor attachment zone was also noted.

2.5 As pests of Thais rudolphi

This edible gastropod is rather common in the rocky areas and is exploited at random along this coast. Samples collected from Angengo, in 1980, as also off Vizhinjam in 1982 were utilised in the present study.

2.5.1 Incidence of boring sponges

No data are available on the incidence of boring sponges among *T.rudolphi* collected off Anjengo in 1980 as it was a sample consisting only of bored shells; but those collected off Vizhinjam in 1982 recorded a percentage of 9.7.

2.5.2 Species of boring sponges

The following five species of boring sponges were found to occur among *T.rudolphi* population in this area, in the order of abundance, 1) *Cliona lobata* Hancock, 2) *C.vastifica* Hancock, 3) *C.margaritifera* Dendy, 4) *C.celata* Grant and 5) *Aka minuta* Thomas. Of the above mentioned species, the last one is a common coral borer and is rarely met with in the molluscan shells.

2.5.3 Abundance and population structure

Samples obtained from Anjengo in 1980 were found infested with 4 species with *C.vastifica* as the major component accounting for about 60% of the population, followed by *C.margaritifera (Fig.2D). The other two species, viz. C.carpenteri* and *C.celata* were found to contribute only a minor share and comprised of only 6.6% each in the boring sponge population. The shells obtained from Vizhinjam, in 1982, presented a quite different combination of species with *C.lobata* as the major pest contributing to about 66.6%. Both *C.vastifica* and *C.margaritifera,* which occupied the first and second position respectively at Anjengo in 1980, had negligible part to play at Vizhinjam in 1982. The composition of *A.minuta* was quite negligible (4.4%).

2.5.4. Damage caused to the shell

Localised attack with more preference to the thickest area was rather a general feature with regard to the sponge infection on *T.rudolphi.* An exception to this general pattern was noted in the case of those shells which were infected by *C.margaritifera* since there was a tendency for this species to ramify the entire shell. The pores produced by this species of sponge on the surface of the shell were, as a rule, smaller when compared with those produced by the same species of sponge on the shells of other molluscs. Pores, in this case, are distributed on both surfaces of the shell alike, and invariably those made inside the shell are left unrepaired resulting in the lysis of the epithelial tissue of *T.rudolphi.*

3. Molluscs (Fig. 5A)

Molluscs play an important role in excavating calcareous objects such as shells, corals, lime stone, etc. Young (1963, *Amer. Ass. Adv. Sci. Publ.*, 75) while reviewing the studies on the boring molluscs, has given

FIG. 5

A. Badly damaged apical portion of *Xancus pyrum*. Those larger openings are made by species of *Lithophaga*, while the smaller ones are made by sponge. B. *X. pyrum* bored by sponge, *Cliona carpenteri*. C. *X. pyrum* bored by *C. vastifica*. Those larger openings are made by boring mollusc, *Lithophaga*. D. Pearl oyster affected by sponge (inner view). Blisters are found at the adductor attachment zone of the shell. Pores made at the inner part are repaired at places by the secretion of nacreous substance.

sufficient details on 7 superfamilies, viz. Myacea, Adesmacea, Petricolidae, Saxicavacea, Gastrochaenacea, Cardiacea, and Mytilacea, and concluded that they have evolved independently of one another, though two major lines in their evolution – epifaunal and infaunal – could be well noticed. Appukuttan (1973, *Mar. Biol. Ass. India, 15* (1)) listed 22 species of coral boring bivalves from the Indian coast. This list was further supplemented by the addition of two more species (Appukuttan, 1974, *J. Malac. Soc. Australia, 3* (1); 1976, *Indian J. Fish., 23* (1 & 2)) making the total 24.

3.1 Species of boring molluscs

Recent investigations on the destruction caused by the molluscs, especially the bivalves, to the commercially important chanks as well as to the coral colonies have revealed the existance of the following 6 species on the south west coast of India, 1) *Lithophaga laevigata* (Q. and G.), 2) *L.bisulcata* d'Orbigny, 3) *Lithophaga* sp., 4) *Botula cinnamomea* (Lamarck), 5) *Venurupis macrophylla* Deshayes, and 6) *Diplothyra* sp.

Among these, the first 4 come under Mytilacea, the 5th under Veneridae and the 6th under Pholadidae. The first record of *L.bisulcata* from the Indian coast is that of Appukuttan (1976, *Indian J. Fish., 23* (1)) and all the other species are reported herein as shell borers for the first time. *L.bisulcata,* a common shell borer in the Indian waters, is also reported here as a pest of corals. The other two coral borers found commonly at Vizhinjam are *L.laevigata* and *V.macrophylla*.

3.2 Abundance and population structure

During the present study, bored chanks ranging in length from 76 to 205 mm from the Gulf of Mannar and 111 to 152 mm from the south east coast were examined. Boring bivalves were found to occur in great abundance among chanks of 125 to 205 mm, whereas those below this size group were seldom found infected. Among the various genera, the genus *Lithophaga* ranked first, dominated by the species *L.bisulcata* on chanks.

Though the rate of infection among the chank population in both the Gulf of Mannar and the south west coast of India varied considerably from place to place, the rate was more in shallower beds as compared with deeper beds.The number of boring bivalves, in individual shell, varied from 5 to 85 in shallow water beds.

3.3. Damage caused to the shell

Both chemical and mechanical methods are employed by the molluscs for boring into calcareous substrata. Lithophags are considered by some to be chemical borers while others attribute a chemical action initially, followed by mechanical means at a later stage. Species like *B. cinnamomea, V.macrohylla and Diplothyra* sp. bore mechanically by the rocking movement of their shell valves.

Burrows made by lithophags on shell are long and cylindrical in outline. The anterior part of the burrow, in cross section, is oval and the posterior, circular. The aperture of the burrow, in the case of *L.laevigata* varies from rounded to dumbbell shaped whereas in *L.bisulcata,* it is oval. The orifice of the burrows of the young lithophags reported herein, is as a rule round and the burrow is partly or completely devoid of any calcareous coating inside, unlike in adults where it is lined by a uniform coating of calcareous matter. The burrow made by *B.cinnamomea,* on the contrary, is pear-shaped, with a perfectly round orifice; rather shallow and devoid of calcareous lining. The burrow made by *Diplothyra,* which is otherwise similar to that made by *B.cinnamomea,* may be easily identified by its mid-vertical ridge inside. Here also no calcareous lining is noted inside the burrow.

The burrow made by lithophags in corals differs considerably from that made in shells. The burrow made by *L.laevigata* in coral is not lined by calcareous matter, while in the case of *L.bisulcata* the anterior part of the burrow may show traces of calcareous lining. *V.macrophylla,* often makes shallow burrows which are oval in shape and with round orifices. The posterior part of the shell, in this species, always projects beyond the general surface of the substratum.

The main target of the boring bivalves is the spire portion of the chank. Sponges, on the other hand, pierce the entire shell giving a honey-comb like appearance to the shell in the advanced stages of infection. The shells infected by bivalves, hence, could be utilised to a certain extent by curio-manufacturers for making buttons or rings, while those riddled by sponges are entirely discarded as no part is left free and intact. At Tuticorin alone 50,000 shells, at an average, are discarded every year due to the infection of various borers.

4. Polychaetes

Though several species of polychaetes belonging to families Nereidae, Terebellidae, Spionidae, and Syllinidae are known to bore into hard calcareous objects, the best known and wide-spread pests of the molluscs come under the family Spionidae and the genera *Polydora* and *Polydorella.* The common species from the Indian region are 1) *Polydora antennata* Claparede, 2) *P.hornelli* Willey, 3) *P.caeca* Oested and 4) *Polydorella prolifera* Angeuer.

4.1 Abundance and population structure

4.1.1. As pests of Chank

There is no account on the rate of infection of *Polydora* spp. on the Indian chank beds. A preliminary study made during the years 1980 to '82 showed that the infection rate of *Polydora* spp. varied considerably from place to place. At Tuticorin beds only 6.6% infection was noted during the 1977-78 season, but during the ensuing season, ie. 1978-'79, it went up to 33%. In 1980, when the chank fishery at Thiruchendur resumed after a long pause, the percentage of *Polydora* infection noted was as high as 40; but during the ensuing season it came down to 20%. The infection in the chank beds off Vizhinjam and Quilon registered 11.7% and 10% respectively during 1980-'81 season

4.1.2. As pests of cultured pearl oysters

The first authentic report on *Polydora* infection among cultured pearl oysters is that of Alagarswamy and Chellam (1976, op. cit.). They recorded an infection rate of 20.7% at Tuticorin initially, but the rate increased considerably after one year of planting the oyster on to rafts. According to above workers, about 78.4% of the infected oysters contained blisters inside the shell. Another major hazard noted is that the polydora ramifications inside the shell make it rather fragile in due course.

The polydora infection noted at Vizhinjam pearl culture rafts is considerably less when compared to that at Tuticorin. During 1980 only 10% of *Pinctada fucata* and 3% of flat oysters were found infected. But subsequently (in 1981) the rate of infection increased to 23%.

4.1.3 As pests of mussels

Cultured brown mussel from Vizhinjam as well as brown and green mussels obtained from the wild were examined during the present study. Natural beds off Mulloor revealed an infection rate of 8.5%, but the infection on the raft-cultured brown mussels at Vizhinjam was practically nil.

4.2. Damage caused to the shell

These small-sized worms *(Polydora* spp.) usually form minute tubes on the surface of the shell initially agglutinating sand and other arenaceous objects. While burrowing, the animal bent the body into a 'U' shaped structure, the arms of which are separated by a partition of sand or mud or both, mixed with mucus. The burrowing is effected, at least in part, by the help of enlarged dorsal setae of the 5th setigerous segment. Whether any chemical action is involved in this process or not is not fully known.

The worm enters into the shell through a small opening made on the surface of the latter, and the entry may take place at any part of the shell. Eventhough several species of polychaetes exhibit the habit of burrowing into shell, only some are capable of producing simple or compound blisters inside. All species of *Polydora* fall under the latter category, and the blisters formed inside the shell often press the soft tissue and this in turn may cause malfunctioning of the epithelial tissue. In rare instances it is noted that the burrow may establish contact with the mantle cavity producing local irritation. When such openings made inside are small, the same is repaired by the mollusc secreting nacreous layer over it. But when the mollusc become old or physiologically weak the worm becomes a permanent irritant to it.

In the case of the genus *Polydora*, normally only one specimen is noted inside each blister, but in the case of the genera like *Syllis* and *Terebella* as many as four specimens could be located inside each blister.

5. Sipunculids

Sipunculids form a major group which play an important role in the destruction of dead corals and are seldom encountered in the living parts of the coral. The common species found in the Gulf of Mannar is *Dendrostoma signifer* Selenka and de Man. The usual habitat of this species is the upper strata of dead corals up to a depth of about 4 cm. The burrows made by this species are oblong in outline and the maximum size attained by this animal is 3 cm.

Though not as common as the above mentioned one, another species, *Aspidosiphon elegans* (Chamisso and Eysenhardt) is also reported from the Gulf of Mannar and this too prefers the upper strata of dead corals. This species is easily distinguishable from the former by its smaller size, say 1-1.5 cm, and dark anterior shield.

It is not fully understood whether the sipunculids obtain all or a significant part of their food from the substratum. Here the cuticular plates act as the chief organ of boring.

General Remarks

The findings presented are based on the study of boring organisms infesting the coral reefs and economically important molluscan beds of the Gulf of Mannar and the southern coast of Kerala during the period 1980-'82. The wide fluctuations noted in the abundance and population structure of the various pests in the molluscan beds during the short period of two years clearly indicate that they are in severe competion for suitable substrata and the shells of gregarious molluscs

which inhabit this area provide ample opportunities for the pests to flourish. The abundance and succession of these pests in the natural beds are always within the predictable limits for the conventional species. But on some occasions such a prediction become impossible, for the migration of unconventional species from nearby beds or the reactivation of any endemic quiescent species may totally alter the natural cycle of abundance at times. The infiltration of *C.lobata,* into Indian beds during 1980, as also the reappearence of *C.margaritifera* at Vizhinjam pearl culture rafts in 1980, may be cited as two examples denoting the two types of colonisation mentioned above. Both these species have, since then, migrated into other beds of a totally different species forming the major component in the respective beds. It is normally noted that any new infiltrant can cause a sudden spurt in the new bed, but gradually the percentage of incidence may come down and this reaction is due to the slackening in the activity of some other less competent species already existing in the bed. On the contrary, in some cases, the new migrant may multiply disproportionately resulting in epidemics. Hence it is essential to estimate the year--to-year fluctuations in the abundance of conventional species of any bed and also the impact of new infiltratant, if any, on a long-term basis.

The incidence of boring sponges is found to be rather high among raft-cultured pearl oysters both at Tuticorin and Vizhinjam. The sponge bores into the shell by chipping off the latter. When the chipping becomes intense the sponge tissue may establish contact with the soft parts of the mantle through the pores made at the inner part of the shell. The mollusc, in order to prevent such a contact, secretes extra quantities of nacreous material and repairs these holes immediately. This may, in turn, cause great physiological stress on the host. How far this stress affects the pearl-producing capacity of the oyster is not known at present and is worth investigating.

It is rather difficult to control the infection of boring animals in the natural beds, but the low rate of incidence recorded year after year under normal conditions suggests that the nature plays an important part in keeping the abundance of these deleterious agents at a lower level, when untampered by extraneous influence. The higher incidence of boring organisms on the culture rafts, on the contrary, is an indication that the ecological inhibition which is at play in the natural beds is no longer in operation in this artificial environment. Hence any management system which places more emphasis on ecological aspects would help in cutting down the incidence of boring organisms at least to a level noted in the natural beds.

Another important observation made during the present study was the wide distribution of the boring sponge *C.vastifica* in the Ashtamudi Lake, Quilon. This species has succeeded in colonishing the estuarine realms in many parts of the world by virtue of its euryhaline nature. Along the estuaries of India too, *C. vastifica* is wide spread and in estuaries like the Zuari estuary of Goa, the incidence of this species is as high as 63% (Thomas and Thanapathy, 1980, *Indian J. Fish.*, 27 (1 & 2) as against a low rate of 2-3% noted in the inshore areas of Goa. Such a high incidence of *C.vastifica* in the estuarine condition may, apart from its euryhaline nature, be due to the availability of the shells of *Crassostrea* spp. in plenty. Hence there is every possibility that this species *(C.vastifica)* may form a major threat to our future rock oyster farms along the estuaries.

The authors are thankful to Shri. C. Mukundan Officer-in-Charge Vizhinjam Research Centre of C.M.F.R.I., for going through the manuscript and suggesting improvements.

CLASH BETWEEN PURSE SEINE AND ARTISANAL FISHERMEN AT COCHIN*

The commercial purse seine fishing operations commenced in Kerala towards the end of 1979 and at present about 60 purse seine units are operated from Cochin base. The introduction of purse seining in Kerala in the traditional grounds has been vehemently opposed by the indigenous fishermen and has, on many occasions, resulted in skirmishes between the two from the very beginning. In order to minimise the tension prevailing between the mechanised and non--mechanised fishermen and as a step towards a better management of the pelagic fishery resources of Kerala coast, the Government of Kerala enacted the Kerala Marine Fishing Regulations Act, 1980. As per provisions contained in the act the area of operation of each type of vessel is clearly demarcated. No mechanised craft is permitted to fish upto 8 fathoms. Countrycrafts and catamarans fitted with outboard motors can operate from 8 fathoms. Mechanised boats of less than 25 gross tonnage, are restricted to operate between 10 and 20 fathoms and purse seine boats are permitted to fish only beyond 22 fathoms. The purse seine boats if caught fishing in banned waters can be fined upto Rs.5000/- or the catch confiscated and the fine increased to five times the cost of the catch.

Recentrly the Government of Kerala started strict enforcement of the Act. In September 1982 the State Fisheries Department seized 6 boats which were found fishing in banned waters and fined Rs.2,000/- each. As a protest against the seizure of the purse seine vessels by the Fisheries Department authorities, the Purse seine boat Owner's Association along with Purse seine boat Thozhilali Union observed one day hartal on 16.9.82, with the support of Cochin Fisheries Harbour Thozhilali Union, Buying agents and merchants' Association, Fisheries Harbour Merchants' Union etc. They also staged a 'dharna' in front of the Office of the Duputy Director of Fisheries, Government of Kerala, Ernakulam. The purse seine boat operators feel that the kerala Marine Fisheries Regulation Act banning purse seining within 22 fathom zone is impractical, unrealistic and unscientific and point out that purse seining in nearby Karnataka and Goa is banned only within 5 km (8 fathoms) of the sea coast.

On 2.11.82 a purse seine boat 'Achumon'was set on fire and sunk off Vypeen Island near Nayarambalam by irrate artisanal fishermen. The indigenous fishermen employing thanguvala in country crafts of Puthuvyppu, Nayarambalam and Munambam fishing villages are of opinion that due to the operation of purse seine boats the sea has turned barren for them. According to them the purse seine boats operate all over the inshore areas and seldom beyond 22 fathom line and as a result they are finding it difficult to operate the thanguvala units economically. Normally the purse seine units operate from very early in the morning making on an average 3-4 hauls daily. The catch is lifted out and transported to the base by carrier vessels, while the purse seine continues to operate in the fishing ground. By the time the catch of the indigenous fihermen reach the coast, the supply would have far exceeded the demand. The special survey conducted by the Central Marine Fisheries Research Institute to find out the impact of the purse seine operations on indigenous fisheries also showed that before the introduction of purse seining traditional fishermen were able to get higher prices, whenever the catch was less. However, the effect of purse seining at the present level of exploitation and availability was not tangibly felt on the indigenous fishery off Kerala coast (Jacob et. al. *Mar. Fish. Infor. Serv. T & E Ser.* No. 40, 1982).

In protest against the burning of the purse seine on 2.11.82 all the purse seiners at Cochin Fisheries Harbour struck work from 3.11.82. The increased violence of the traditional fishermen against purse seine fishermen had also recently resulted in the burning of the boats 'Veera Ratna' and Mahalakshmi'. The strike continued for more than a week, upto 10.11.82. As a consequence of this the Fisheries Harbour had a deserted look (Vide Photographs). With the already reduced activity of drift gill nets and shrimp trawlers at the Fisheries Harbour due to poor catch and as the protest strike by the purse seiners also continued a near fish famine was felt at Cochin and adjacent areas, with the cost of fish skyrocketing.

During the purse seining season about 55-60 purse seine units are operated from the harbour bringing an average catch of 100 tonnes of fish per day. The average estimated loss of catch during the strike period would have been about 800 to 1000 tonnes of fish consisting mostly of small sized oil sardine in the sizer range of 95-120 mm, as assessed from the trend

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*Prepared by K.V.Somasekharan Nair and A.A. Jayaprakash with the guidance of K.V. Narayana Rao.

Purse seiners and carrier boats lying idle at Cochin Fisheries Harbour due to strike on 3.11.82.

of purse seine landings immediately prior to and after the strike. The price of juvenile sardine fluctuated between Rs.500/- to Rs.800/- per tonne indicating that the total loss during the strike period would have amounted to between Rs.5.2 to Rs.6.5 lakhs. There was good demand even for cheap and trash fishes like small carangids (mainly *Alepes kalla*), juveniles of small sized sciaenids *(Johnieops dussumieri, J.sina, Kathala axillaris* and *Otolithes ruber)*, flat fishes *(Cynoglossus macrostomus)* etc. which were marketed for prices ranging from Rs.1.5 to 2.0 per kg. Usually when there is good purse seine landings, these catches are mainly used for drying and very seldom marketed fresh. The price of quality fishes like pomfrets and seer fishes shot up. The purse seine strike made a majority of the nearly 5,000 workers employed at the Fisheries Harbour in connection with the handling of fish catches under employed. On an average 17 hand carts, 47 auto trucks, 154 bicycles, 24 tempos and 35 lorries come to the harbour every day. The production of ice in the factories near Cochin also was greatly reduced.

While the purse seine boat fishermen condemn the State Marine Fishing Regulation Act demarcating the area of fishing for purse seine boats, the traditional fishermen insist that if the law is not stricltly enforced the traditional fishermen would become extinct due to starvation. The purse seiners while steaming out for fishing from the harbour very early in the morning often sight shoals very near the shore, which they usually fish. Off fishing villages like Puthuvyppu, Nayarambalam, Vypeen etc. the operation of purse seine boats can be seen even from the shore, which generally leads to tension between the indigenous and purse seine fishermen. It may also be noted that the motorisation of the country crafts with out-board engines has also not picked up to the same extent in these villages, as in the fishing villages of south Kerala.

The purse seine boats resumed fishing operations from 10.11.82 based on the discussions held at Trivandrum between the boat owners and the State Government authorities. However only few units ventured into

the sea for fishing fearing attack from the artisanal fishermen; the number of purse seines operated on that date being only 6 with 12 carriers. Their catch consisted of mainly juvenile oil sardine in the size range 95-120 mm. On 11.11.1982 there was no operation of purse seine boats from the harbour. However, from 15.11.1982 all the purse seines started fishing and landed good quantities of oil sardine. In December 1982 the State Fisheries Department impounded 15 purse seine boats for fishing in the prohibited waters. All these boats were fined Rs.5,000/- each. The tension between artisanal and purse seine fishermen is also continuing unabated. On January 10, 1983 members of some associations of the artisanal fishermen of nearby fishing villages of Cochin staged a 'dharna' at Ernakulam demanding total ban on purse seine fishing. Perhaps, due to some of these factors and pressures, some of the purse seine units have already shifted the area of operation from Kerala coast. At present only about 25-30 purse seine boats are operated from the Cochin Fisheries Harbour per day, whereas about 56-60 units were fishing daily in 1981 and 1982.

Banning of purse seines in Kerala cannot be considered a long range solution for the problem. The Kerala coast is rich in pelagic fish wealth. Sardines and mackerels are the most important pelagic fishes as far as the traditional fishing methods are concerned. The indigenous fishing crafts alone cannot exploit the entire resources and if so left to them, the cost of fish is bound to skyrocket. In order to minimise the resentment of the artisanal fishermen to purse seine fishing, the patrolling of the sea to check fishing in the banned area should be intensified. But the fisheries department is helpless due to lack of infrastructure and manpower. The moment a patrol boat is cited the purse seine boat leaves the catch and speeds away. So proper petrolling in order to prevent the purse seiners operate in the banned area is a great necessity.

At present there is no co-operative society for fishermen in this area. As in the case of all other trades, the middlemen are exploiting the fihsermen who acutally undergo all the hardships in the sea and get only a meagre share. One possible way of aiding these fishermen is that the Central and State Governments and scheduled banks should extend liberal credit facilities to artisanal fishermen both on individual and co-operative societies and each such society can be entrusted with a limited number of purse seine units which should operate within the specified area. This will also help in spreading out the purse seine fishing effort more uniformly along the coast, preventing unhealthy concentration of fishing effort in certain specified areas and would probably help in minimising the conflict between the fihsermen.

SPURT IN FISH LANDINGS ALONG NORTH TAMIL NADU COAST*

In the second fortnight of August, 1982 a sudden spurt of unusually heavy fish landings was noticed along the northern part of Tamilnadu coast extending from Pondicherry to Madras. Some of the species of fishes represented in the catches being occupants of deeper water, a probable movement of deep water fishes into the inshore areas has occurred during this period. Certain details of the landings of a few centres along the coast during the time are presented.

Pondicherry

The heavy fish landings were observed from 17.8.1982 to 31.8.1982 in landing centres adjacent of Pondicherry, viz., Chinnamudaliarchavadi, Nochikuppam, Cholakandikuppam and Kanakachettykuppam. The catches comprised mainly of *Caranx* spp., Soles, *Nempiterus* spp. *Saurida* spp., cuttlefish and coral fishes and were fished by indigenous gears like bag net, shore seine, gill net and boat seine.

The landings ranged from 0.5 to 6.5 tonnes per day (Table.1). Due to the heavy catches, there was glut in all the landing centres of this region, resulting in very low market value for the fishes. For instance, the normal cost of *Decapterus sp.*, about Rs.3 per kg. fell to Rs. 0.75 per kg. Consequently the fishermen did not go out for fishing for a day or two in some of the landing centres.

Kovalam

Whereas the temporary heavy landings lasted for about 15 days in Pondicherry region, the same was noticed in Kovalam region only for 2 days, viz., on 23.8.'82 and 24.8.'82. On 24.8.'82, about 3.3 tonnes of fishes were landed at Kottivakkam, mainly by shore seines (2 units). Of the 3.3 tonnes landed here about 2.3 tonnes were constituted by *Leiognathus bindus*.

At Kovalam landing centre, about 2.3 tonnes of fish were landed by boat seines (31 units). The catch consisted mainly of coral fishes, *Leiognathus* spp., *Nemipterus* spp., *squilla* spp., and *Sepia* spp. Interestingly some of the fishes, crabs and prawns, which normally inhabit deep waters were caught in boat seines operated in 4 m depth on that day

Fishes: *Psenes indicus, Chaetodon vagabundus, Holocentrus rubrum, Pseudorhombus triocellatus, Plectorhynchus pictus, Apogon multitaeniatus, Archamia lineolata, Scolopsis vosmeri, Pempheris moluca, Opisthognathus muscatensis, Ichthyos copus, Synaptura zebra, Caesio caerulaureus, Abudefduf* sp., *Alectis indicus, Hoplobrotula* sp., *Brotula maculata* and *Epinephelus tauvina.* (Fig.)

Prawns: *Metapenaeus monoceros, Parapenaeopsis* spp., and *Trachypenaeus* sp.

Crabs: *Portunus hastoides, P.gladiator, Charybdis, Callianassa, Dorippe (Dorippoides) facchino, Philyra globulosa*

Madras

Similar rise in landings were observed in Madras also. At the Kasimedu landing centre for mechanised trawlers there was an abrupt increase in landings from 26.8..1982 lasting upto 30.8.'82 (Table 1). On these days the landings ranged from 30 to 44 tonnes per day. In the previous month of July the average landing was 22 tonnes per day, thus recording 1.5 to 2 fold increase in fish landings during this period. The major constitutent in the catch at Kasimedu was *Nemipterus* spp. While *Nemipterus* spp. formed 17.1% of total trawl catch in July, the percentage composition of these fishes rose to 49.3 on these days. A few specimens of *N.metopias*, which is rarely recorded from these waters were also present. *Saurida* spp., *Sepia* spp. and coral fishes were the other varieties represented in the catches. Most of the private boats operated in inshore waters (15 m depth) during this period.

Environmental conditions

During the period of high landings it was noticed that there was a slight fall in surface water temperature along the north Tamil Nadu coast. The average surface water temperature off Kovalam dropped to 26.8°C on 24.8.'82 from the normal average temperature of 29.1°C recorded during the period from 1.8.'82 to 22.8.'82. Swarms of *Noctiluca miliaris* were also observed on 24.8.'82, one of the days of high landings of fishes.

Results of analysis of water samples collected off Madras on two days of heavy landings, making use of Cadalmin III are presented in Table 2. A notable feature is the low oxygen concentration (1.10 to 1.37 ml/l) and low temperature (26.2 to 27.2°C) during

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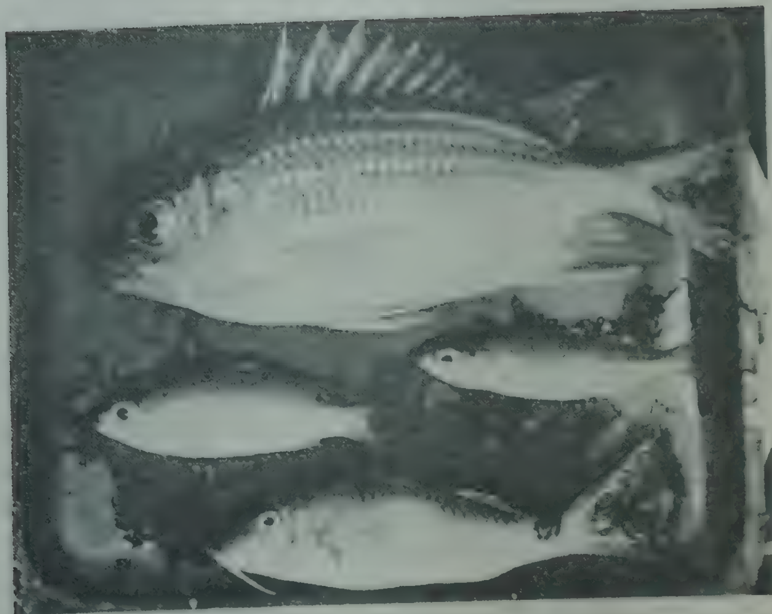
*Prepared by E. Vivekanandan, M. Kathirvel, V. Selvaraj, K.G. Girijavallabhan, M. Rajagopalan and L. Chidambaram



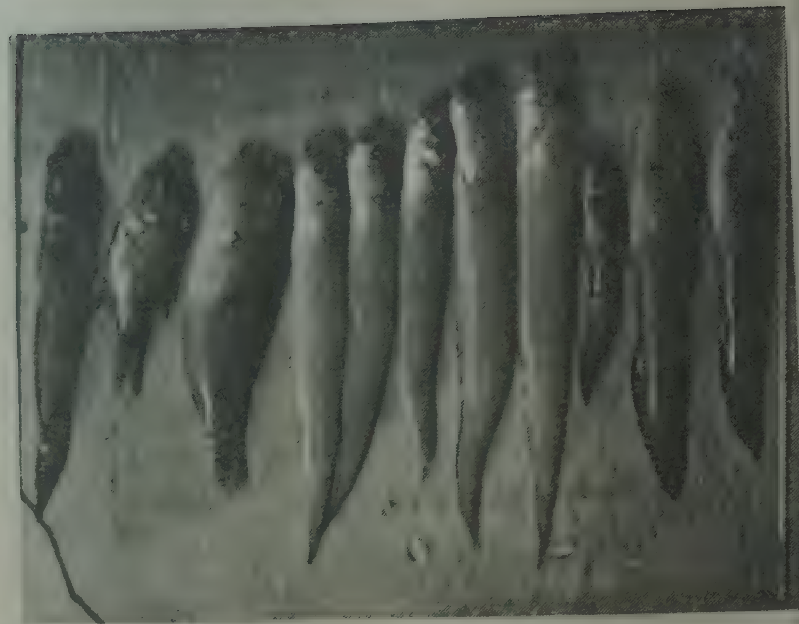


Fig. Some species of fishes caught during the fortnight

Table.1. *Estimated landings (in kg) at different centres of north Tamil Nadu coast during the second fortnight of August, 1982. (Major categories in the catch in parentheses)*

Date August 1982	Pondicherry	Kovalam	Kasimedu (Madras)
17	2,000 (*Caranx, Nemipterus*)	175 (*Trichiurus*)	No data
18	5,000 (*Caranx*, Soles, Coral fishes)	No fishing	-do-
19	4,000 (Sciaemids, Soles, Coral fishes)	100 (*Dussumieria*)	18,420 (*Nemipterus, Saurida*)
20	No data	No data	No data
21	-do-	-do-	-do-
22	-do-	-do-	-do-
23	No fishing due to glut	500 (Coral fishes, *Nemipterus*)	20,978 (*Nemipterus, Sepia*)
24	6,500 (Soles, Rays, *Saurida*)	2,300 (Coral fishes, *Nemipterus*) 3,300 (at Kottivakkam) (Silverbellies)	No data
25	3,000 (*Upenoides, Serranus*)	25	-do-
26	500 (Coral fishes)	8	43,917 (*Nemipterus, Saurida*)
27	No data	82 (Tuna)	30,104 (*Nemipterus, Sepia*)
28	-do-	80	No data
29	6,000 (*Epinephelus*)	No data	-do-
30	No data	-do-	33,370 (*Nemipterus, Sepia*)
31	-do-	-do-	16,974 (*Nemipterus, Saurida*)

Table. 2. *Hydrographic conditions in different areas off Madras*

Date August '82	Station	Depth (m)	Dissolved O_2 (ml/l)	Temperature (°C)	Salinity (‰)	Plankton
20	12.80/6B	10 Surface Collection	1.10	26.2	34.3	Swarm of *Noctiluca miliaris*
	13.80/1C	30 Surface Collection	1.37	27.2	34.0	-do-
	13.80/1C	30 Bottom Collection	No data	27.2	33.3	—
30	12.80/6B	30 Surface Collection	1.31	27.2	34.3	Swarm of *Noctiluca miliaris*

these days. In the month of July the average oxygen concentration off Madras was 3.53 ml/l and water temperature 29.2°C.

Analysis of plankton samples (horizontal and oblique collections) collected on 20.8.'82 and 30.8.'82 in the areas mentioned in Table 2 revealed swarms of *Noctiluca miliaris* on both days. In a subsequent collection on 4.9.'82, a bloom of *Chaetoceros* sp. was observed.

Remarks

The increased landings were observed off Pondicherry from 17.8.'82, off Kovalam on 23 & 24.8.'82 and off Madras from 26.8.'82, pointing to a possible drift in the commencement of the heavy landings from south to north direction in the northern part of Tamil Nadu coast. This might probably indicate that the sudden movement of the slightly deeper water inhabitants of the coast caused by some unknown factor struck the coast in the southern area first and slowly moved towards the north upto Madras. There are indications that this unknown factor may be the sudden upwelling taking place in this area. The swarming of *Noctiluca* sp. along with fall in temperature at the time of high catch would suggest the occurrence of upwelling, driving the demersal fishes towards the shore.

We are thankful to Dr. B. Krishnamoorthi for going through the report and offering valuable suggestions. The help rendered by S/Shri M.Bose, S.Chandrasekar and T. Dhandapani is gratefully acknowledged.

EXPLOITATION OF CLAM SHELL DEPOSITS IN THE KUNDAPUR ESTUARY*

The Kundapur estuary is the largest estuarine system in the Dakshina Kannada district of Karnataka with a water spread of about 26 sq. km, situated about 100 km north of Mangalore, and is important for clam landings. Till recently the sub-soil shell deposits in the estuary were exploited on a very limited scale due to poor demand. The establishment of a polyfibre industry in•Harihara has opened up a new avenue for lime shell utilisation and, consequently, lime shell production has attracted the attention of poor people. The introduction of a simple but effective device for collection of clam sheils in 1975 proved to be a turning point in the exploitation of the resource. The shell deposits are comprised of *Meretrix casta* - 40%, *Meretrix meretrix* -25%, *Paphia malabarica* -25% and others (*Anadara Cerethedia* and oysters) - 10%.

Description of shell dredge

The dredge used for the collection of shell deposits is locally called "machine" (Fig.1). It consists of a semicircular iron ring, to the free ends of which is fitted a slightly curved iron base plate of about 42 cm length, having 19-20 spikes pointing downwards. The height of the plate with spikes is 4.5 cm. To the middle of this spiked plate, an iron piece (about 13 cm length) is rivetted to which a wooden piece of about 60-65 cm is attached. A bamboo pole, 6.5 m long, is tied to the wooden piece. An iron chain of about 3 m length is rivetted to the free ends of the ring. To the middle of this chain a nylon rope of about 10-11 m is tied. The arrangement facilitates dragging of the dredge over a pulley attached to the boat. A net is attached to the device to hold the shells being dredged. To the cod end of the net a 2m rope is tied on the inside, which could be pulled up and down for cleaning the shells.

Operation of dredge

A pair of boats is employed for the operation of the dredge. Each boat is manned by two persons. Usually they go out for collection early in the morning and return by mid-day. Initially the estuarine bed is sounded to detect the shell deposits. The shell collectors thrust a bamboo pole into the bed till the shell layer is reached and drive it deeper to know the thickness of the bed which is measured by the sound made by the thrust of the pole through the shells. The prospecting is usually not carried out daily as one site may yield shells for a few days.

Each boat is tied to 2 to 3 casuarina poles fixed in the river bed. The second (rear) boat is positioned parallel in line with the first boat in such a way as to leave a gap of 1 m in between, also lying 1 m to the left of the first boat. The dredge is driven well into the bed from the first boat and the rope is pulled up over the pulley in the rear boat. A person in the first boat takes charge of the cleaning rope. The dredge is pulled to collect the shells which are cleaned by lifting the cod end of the net. Then the shells are emptied into the first boat. Each operation normally takes 2-3 minutes. In a single operation about 10 to 20 kg of shells are hauled up depending upon the thickness of the shell layer. The boats used for collection of shells are usually of 1 tonne capacity. Each site may yield shells for one or two weeks before it gets exhausted. The site again becomes productive after a couple of months or more, with the filling of shells due to movement of the loosened layer of shells around it.

Shell Production

A unit of a pair of boats collects about two tonnes of shells a day. There are about 85 units operating in Kundapur estuary. During the south-west monsoon season the number of units may be as high as 125, as the fishermen gets a gainful occupation during the off season. The total production of shells varies from 150 to 175 tonnes per day. Boats of 10 tonnes capacity are used for transporting shells from the collection sites to the selling point. Mechanised shell washers with running water are used for further cleaning shells. In this process small broken pieces of shells, sand and mud constituting about 10-15% are removed. A co-operative organisation "Swawalambi Sangh" of Kundapur, purchases all the lime shells directly, eliminating the middlemen, and thus protects the economic interests of shell collectors. The shells are sold by the Sangh at Rs 85-100/tonne at Kundapur.

The estimated production of lime shells in Kundapur estuary during 1975 to 1982 (July-June) is given below:

Year	Production (tonnes)
1975-76	13,500
1976-77	21,540
1977-78	22,000

*Prepared by G. Syda Rao

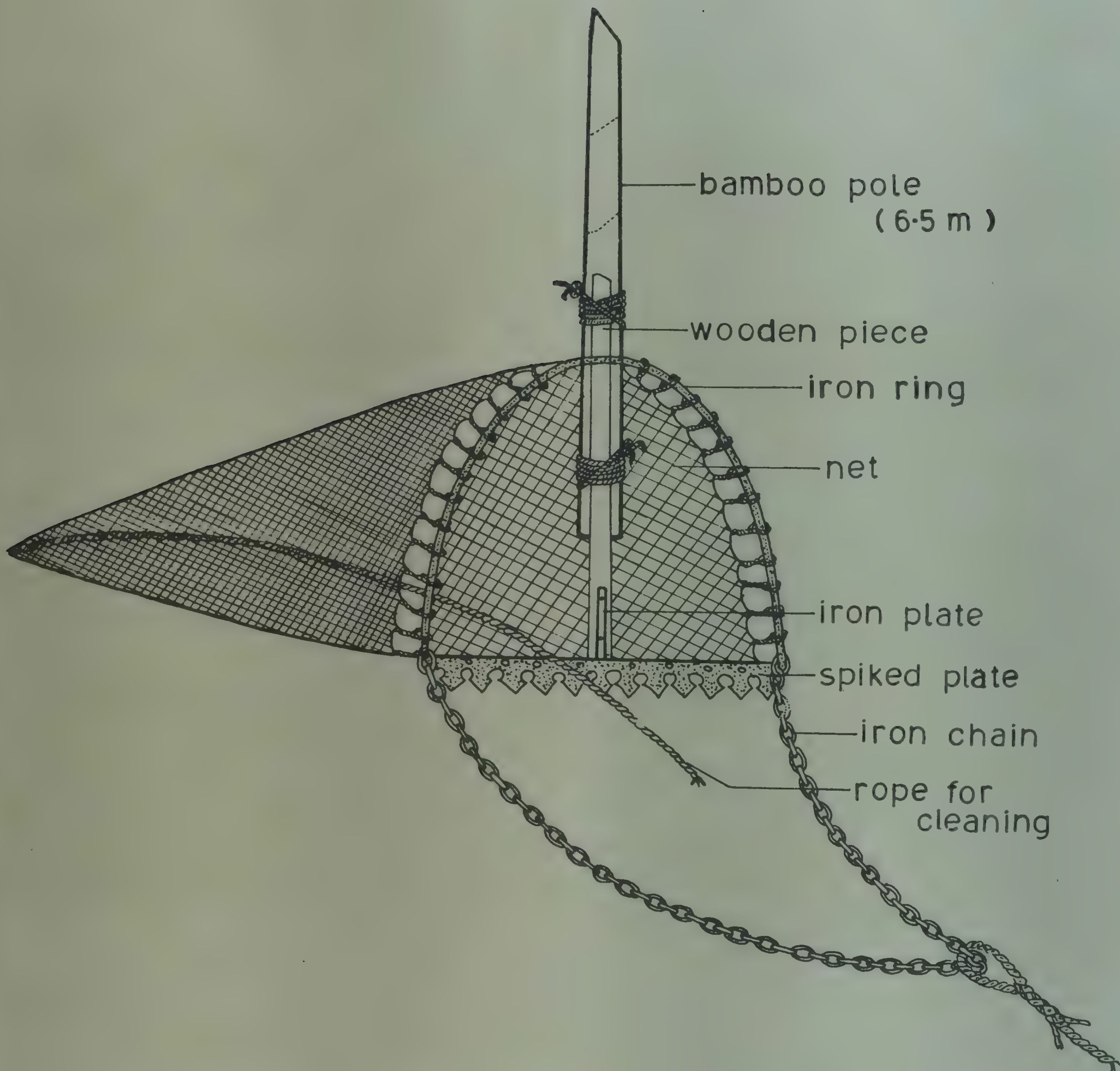


Fig.1. Construction details of shell dredge.

1978–79	19,680
1979–80	22,470
1980–81	29,540
1981–82	14,325
1982–83	6,000
(Upto Dec. '82)	

Utilisation

As stated earlier the major user of these shells is the Harihara polyfibres. The shells form an important component of 'Chemical recovery process' in most of the pulp (paper and rayon) industries. The shell lime is also used for treatment of effluents, to neutralise soils of coffee and tea plantations, and as a pesticide by mixing with copper sulphate. The finer bits of shells are mixed in the poultry feed.

Present status of shell collection

About 450 people are employed practically throughout the year. At present the shell collection is concentrated around. 'Uppena Kuduru' is let in the estuary. This estuarine area is about 138 ha and was leased out for 20 years, by the Department of Mines and Geology, Government of Karnataka to the first five

Fig.1 General view of Kundapur estuary, showing a number of units engaged in shell collection

Fig.2. Dredge, locally called "machine", hauled with shells.

Fig.3. Close-up view of the pulley attached to the rear boat to pull up the dredge.

Fig.4. A view of heaps of cleaned shells near a lime factory at Kundapur.

years and Rs.36, during the rest of the 15 years. Further, they have to pay Rs.4/tonne of exploited shells as 'royalty'. In addition to Kundapur estuary, about 247 ha in the Byndoor estuary and 293 ha in the Udyavara estuary have already been leased out for the exploitation of shell deposits. The deposits are noticed 1 to 1.5 m below the soil and the height of water column over the bed varies from 1.5 to 3 m.

General remarks

Very rarely a few live clams are found in the dredge collections at present, indicating absence of clam beds. But this area was known to yield good quantities of live clams, particularly *Paphia malabarica*, till 1978-79. Continuous dredging might have disturbed the substratusm and prevented the settlement of clams. Extensive operation of dredge has adversely affected one of the clam beds in the sea between Gangoli and Uppena Kuduru. Regulatory measures are necessary for proper management of clam resource in these estuaries keeping the long-term benefits in view.

The author is thankful to Dr.E.G. Silas, Director, C.M.F.R.I for encouragement and to Dr. K. Alagarswami, Head, MFD, for suggesting the study, guidance and critically going through the manuscript. Also thanks are due to Shri K.Devadas Pai, Swawalambi Sangh, Kundapur and Department of Mines and Geology, Mangalore, for their help.

PROVEN TECHNOLOGY

6. TECHNOLOGY OF OPEN-SEA MUSSEL CULTURE

Highlights: A technique for the culture of the green mussel *Perna viridis* is the open sea has been developed. Mussel seed collected from the intertidal rocky beds and/or produced in the mussel farm through spat collection on ropes are securely wrapped around ropes. The seeded ropes are suspended from rafts moored in the sea at a depth of 8-10 m. The seed mussels get attached over the ropes within one or two days. The growth of mussels in the farm is faster compared to the mussels in the over-crowded natural beds. In the farm they reach the harvestable size in five months from seeding.The production per metre length to rope is 10-12.3 kg of mussels and the cultured mussels give a meat yield of upto 40 per cent. Such high production is possible due to the three dimensional culture where in the entire water coloumn below the raft is used for production and the mussel feeds directly on primary producers namely phytoplankton. The technique for the culture of brown mussel *Perna indica* is the same as for the green mussel.

Operational details: Mussel culture in the open sea is done from floating rafts varying in size from 5 x 5 m to 8 x 8 m. The rafts are constructed using teak and bamboo poles lashed together with ropes and are mounted on 5-6 cylindrical metallic floats of 200 1 capacity to get the correct buoyancy. The raft is moored in the open sea at 8-10 m depth by 2 anchors each of 100 kg and anchor chains of length 3-4 times the depth.

Collection of mussel seed for the farm is done from the intertidal mussel beds after the peak spawning season. One can easily collect about 10-20 kg of mussel seed in an hour. The average seed size for forming is 15-25 mm and 600 g seed are required for seeding one metre length of rope. Synthetic and coir ropes of 15 to 20 mm diameter are suitable for growing mussels from the rafts. An optimum number of 60 ropes each having 6 m seeded length can be suspended from a standard raft of 6 x 6 m. After suspension of ropes, the mussel culture farm needs only minimum attention to see that the rafts are in position and in good shape and the ropes with growing mussels remain hung properly. Growth of the mussels in the farm at Calicut ranges 11.6-12.9 mm in length and 5.9-7.3 g. in weight per month. A production rate of 10-12.3 kg per metre length of rope would be possible, which is about 20 times the average seed weight. Harvesting is down at the end of 5 months by bringing the ropes ashore with the help the canoes and removing the mussels. The mussels are cleaned of all the fouling organisms such as barnacles and are depurated in clean sea water before they are marketed.

Fig.1 Mussel culture rafts moored in the sea

Fig.2. Canoe loaded with ropes bearing cultured mussels harvested from the farm

Production: One standard raft of 6 x 6 m holding 60 rops will products 3600 kg whole mussels or 1260-1440 kg meat.

Investment and cost: The materials required for a standard raft are 10 teak poles, 12 bamboo poles, 2 anchors, 2 anchor chains and 70 kg nylon ropes. These capital items will be good for 3 years except anchors which will have a longer life and the expenditure on these will be Rs.5500. Contingent expenditure on floats, knitted cotton cloth, seed collection, seeding,

maintenanace and labour for operation of one raft will be Rs.4500 for 3 years. The total cost for 3 years would be Rs.10,000

Turn over of mussel farm: In a three-year mussel culture project, total production from each standard raft would be 10 tonnes of whole mussels. At an average cost of Rs.2000 per tonne the turn over will be Rs. 20,000.

Constraints and prospects: Considering the rough sea conditions prevailing during monsoon, open-sea mussel farming can be carried out only during part of the year for a single crop. Technology for year-round mussel culture is under development. Availability of seed for large-scale farming is a serious constraint. The natural mussel beds can provide seed on a limited scale. Technology for hatchery production of seed is being developed to overcome the seed problem. Marketing aspect has to be looked into as mussel is a popular food only in some coastal sectors. A small export potential for processed mussel meat exists. In view of the very high production rate, mussel culture holds great promise for increasing protein-rich seafood production.

NEWS — INDIA AND OVERSEAS

Unusual catches of squids in Orissa coast

Along the coast of Ganjam District in Orissa, the shore seine operations generally commence in September and last till April. In 1982, the season prolonged upto June. The shore seines are operated at a distance of about ½ km to 1 km from the coast at a depth of 5 to 10 m. Usually the squid, *Loligo duvaucelii* contributes to a maximum of 4-5 kg per unit in the shore seine catches along the coast during the period. Unusual catches of squids occurred here in March and April 1982, the shore seines landing about 20-25 kg per unit on most of the days. About 30 shore seines which operated on 29.4.1982 along the Gopalpur coast between Bandar and Bakshipeta landing centres were estimated to have landed nearly 1 tonne of squids. Such unusual landings of squid had not been witnessed in this area before.

Reported by Ramasomayajulu and K.Dhanaraju

Juvenile whale sharks landed

Most of the records of occurrence of the whale shark *Rhincodon typus* Smith from Indian coastal waters are from the southeast and southwest coasts. There were five earlier reports of the capture of the species from the east coast and three from the west coast. The present report deals with the capture of the two specimens of the whale shark from Keelakarai in the Gulf of Mannar.

One of the specimens was caught by fishermen on 7.2.1983 at 4.00 hrs in gill net (Pachi valai) operated by a thirty foot length mechanised boat near Appa Islands at about 20-30 m water depth. The net was partly damaged while bringing the whale shark by the mechanised boat to the shore at 11.00 hrs. The whale shark measured 4 m in length and weighed about 2 tonnes. The specimen was cut into pieces immediately after landing and burried in the sea shore. Thus morphometric measurements and other details could not be collected.

Fig 1. Whale shark *Rhincodon typus* Smith landed at Keelakarai

The other specimen was caught on 23.2.1983 at 16.00 hrs in a gill net operated by a non-mechanised boat and towed to the Keelakarai landing centre. The whale shark was a male, measuring 4.75 m and weighing about 2.5 tonnes (Fig.1). The body measurements of this specimen are as follows:

Fig 2. Whale shark landed at Karwar.

Morphometric characters	Measurements (cm)
Total length (Snout to the tip of caudal)	475
Tip of snout to origin of first dorsal	247
Tip of snout to origin of second dorsal	348
Tip of snout to origin of anus	298
Maximum height of the body	200
Height at the second dorsal	133
Height at the caudal origin	68
Width of mouth from angle to angle	79
Distance between two eyes	105
Length of first dorsal fin	59
Width of first dorsal fin	44
Length of second dorsal fin	37
Width of second dorsal fin	23
Length of pectoral fin	90
Width of pectoral fin	62
Length of pelvic fin	39
Width of pelvic fin	62
Length of anal fin	36
Width of anal fin	22

Reported by P. Nammalwar and S. Krishnapillai

It is reported that another specimen of *Rhincodon typus* has been caught in a purse seine operating in 15–18 m depth at about 2 km north of Karwar light house on 18th March 1983. The specimen measured 5.35 m from the tip of snout to the tip of upper caudal lobe, (Fig.2)

Reported, by M.H. Dhulkhed

Unique pollution detection method

A new "biosensor" designed for continously monitering water pollution has been developed by a researcher Mr Jean-Louis Huve of the Pierre and Marie Curie University at Paris. The basic layout of the new technique is a fish 'hooked'to a computer.

Fishes have a very higly developed sense of small that enables them to detect extremely low concentrations (even a few isolated molecules in the case of amino acids) of natural or artificial substances in water. It is this characteristic which enables salmon to find out their migration routes. This has also been put to use since long in some drinking water pumping stations by studying the behaviour of trout in order to detect signs of pollution.

Mr Huve has made use of this idea in developing the electronic technique to monitor the pollution. In his instrument the electrical activity of the fish's olfactory bulb is recorded with two electrodes. A transmitter, working in a frequency band of 1 to 25 H picks up and transmits the current impulses (of about 50 microvolts) to a micro-computer. These are then decoded to show the electrical activity of the olfactory bulbs and a spectral analysis is made of the "electrobulbogramme" obtained. In this way it is possible to determine the polluting substance detected by the fish. The presence of pollutants can be easily recognised by the strong disturbance of the spectrum.

The instrument of the size of a small box, attached to the dorsal aspect of the head of the trout, is capable of indicating in half a second the presence of a gram of pesticide in 100,000 m^3 of water - ten times below the concentrations prescribed by European safety regulations for drinking water. A French company 'MONDIALCOM' is planning to market the detector, which would not cost more than 60 to 75 thousand Rupees, according to an official of the company. Mr Huve is at present trying to develop his tehnique for application to marine pollution detection, using bass instead of trout. He believes that atmospheric pollution detection also would be possible by a similar type of equipment fixed on rats..

CEDUST Bulletin, November 1982.

Compiled and prepared by M.J. George, S.K. Dharmaraja & G. Subbaraju.
Published by Dr. M.J. George, Senior Scientist on behalf of the Director, Central Marine Fisheries Research Institute, Cochin-682 018 and printed at PAICO, Cochin-31.

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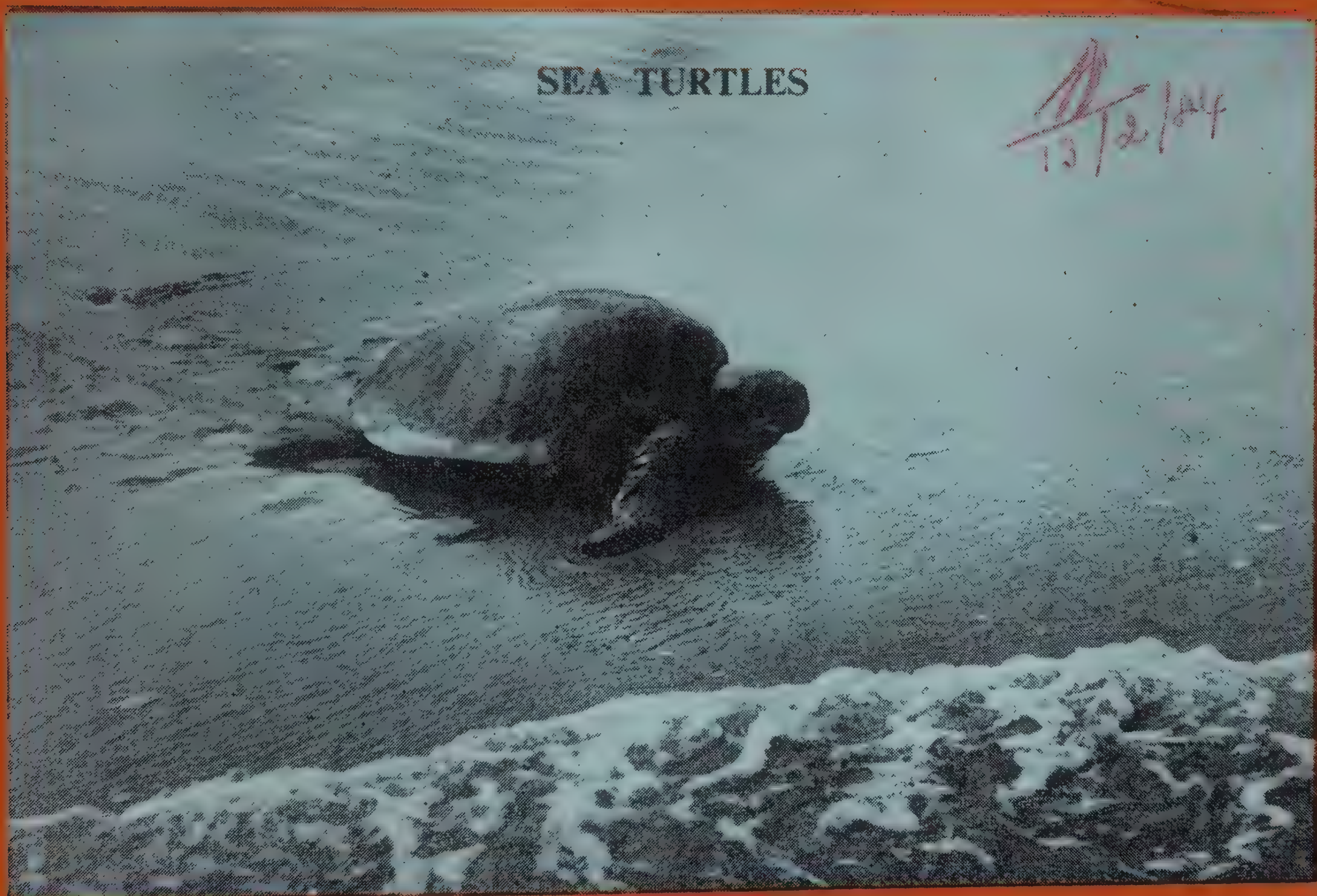
MARINE FISHERIES INFORMATION SERVICE

SPECIAL ISSUE ON
MANAGEMENT AND CONSERVATION

SEA TURTLES



Technical and Extension Series

No. 50

JUNE, 1983

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE

COCHIN, INDIA

INDIAN COUNCIL OF AGRICULTURAL RESEARCH

THE MARINE FISHERIES INFORMATION SERVICE: Technical and Extension Series envisages the rapid dissemination of information on marine and brackish water fishery resources and allied data available with the Fishery Data Centre and the Research Divisions of the Institute, results of proven researches for transfer of technology to the fish farmers and industry and of other relevant information needed for Research and Development efforts in the marine fisheries sector.

Abbreviation — *Mar. Fish. Infor. Serv. T & E Ser.*, No. 50 : 1983.

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4. Nesting site and hatching of the Hawksbill turtle along Tirunelveli coast of Tamil Nadu.
5. Leatherback turtle *Dermochelys coriacea* washed ashore at Kovalam, Madras.
6. Conservation of fresh water turtles of India.
7. Central Marine Fisheries Research Institute turtle hatchery programme, Kovalam, Madras.

Cover Photo: Olive ridley back to sea after egg laying.

SEA TURTLES OF INDIA — NEED FOR A CRASH PROGRAMME ON CONSERVATION AND EFFECTIVE MANAGEMENT OF THE RESOURCE

E.G. SILAS, M. RAJAGOPALAN and A. BASTIAN FERNANDO

Introduction

Great interest is now focussed on the study of sea turtle resources in our Exclusive Economic Zone to develop proper conservation and management measures. The turning point has been the promulgation of the Indian Wildlife (Protection) Act (1972) wherein all species of marine turtles have been placed as endangered species in Schedule I and are thereby completely protected. Nevertheless, there has been a subsistence fishery for the Green turtle and the Olive Ridley, the former in the Gulf of Mannar and the latter as a much larger directed fishery along the Orissa and West Bengal Coast primarily to cater to the Caluctta market. The 1980–'83 period has seen a phasing out of these directed activities. However, poaching in limited scale cannot be ruled out in some areas along our coast where people have been "addicted" to eating turtle meat or taking turtle blood as an efficacious remedy for certain ailments.

A major threat today is the incidental catch of turtles in gill net and trawl fishing operations. The last two years have seen large numbers of live turtles thus caught either being mutilated and removed from the nets and thrown out in the open sea to be washed ashore dead or where gill nets are used over long hours the animals 'drown' and the carcass thrown out is again washed ashore. We have to find feasible ways and means of regulating fishing activity during periods when turtles congregate close to inshore. Implementation of such management measures, though it may take time, should be pursued vigourously combined with an intensive extension programme on conservation. It is our responsibility to make the artisanal fishermen who may be involved in small-scale operations aware of the need for the protection and propagation of these animals.

On and off we have reports, particularly along south Tamil Nadu and Kerala Coast about turtle poisoning mainly caused by eating the meat of the hawksbill *Eretmochelys imbricata* during certain seasons.

All these point to the need for developing a good monitoring system for understanding the resource, advancing our knowledge on the biology, life history and behaviour of turtles and utilising the information for developing proper management strategies. It is with this view that at the recent National Workshop on the Acquisition and Dissemination of Data on Marine Living resources of Indian Seas (*Mar. Fish. Infor. Serv. T & E Ser.* No. 46, January 1983), an important recommendation was made on the need for collecting data on endangered and rare marine species such as turtles and Cetaceans reading as follows:

"The Workshop,

noting that the populations of certain valuable species in the sea are showing decreasing trend due to exploitation, mortalities and other reasons and some of the endangered species such as the dugong, lesser cetaceans including dolphins and the turtles occur as incidental catch in fishing operations,

stressing that it is essential to conserve those species showing declining population structure through appropriate management and conservation measures,

recommends that all data/information pertaining to resources, exploitation and mortalities due to strandings and incidental catches in fishing operations of endangered marine mammals and turtles be collected and made available to the NMLRDC for analysis and action.

Action to be taken by: World Wildlife–India; Department of Fisheries, Governments of maritime States and Union Territories; Bombay Natural History Society; Public and private sector organisations/companies engaged in fishing directly/through charter; National Institute of Oceanography; Naval Physical Oceanographic Laboratory; CMFRI."

The proformae developed at the Workshop for the various types of fishing activities have also to report sightings and other details on sea turtles.

Sea Turtles of India

We have five species of sea turtles as follows:

Scientific name	Common name	Vernacular (Tamil) name
Dermochelys coriacea	Leatherback turtle	Elu varai amai; Thoni amai
Eretmochelys imbricata	Hawksbill turtle	Alungamai
Chelonia mydas	Green turtle	Peramai
Lepidochelys olivacea	Olive ridley turtle	Sithamai
Caretta caretta	Loggerhead turtle	Perunthalai amai

Data Acquisition

We have given here with the aid of simple line drawings and photographs, field identification characters for these species so that species-wise information on sightings, incidental catch in fishing operations, observations from the nesting grounds during the breeding seasons and so on could be collected in the proformae which have been designed (Annexe I, II, and III) and sent to the National Marine Living Resources Data Centre (NMLRDC), Central Marine Fisheries Research Institute, Cochin-682 018 for further analysis and advice.

The Central Marine Fisheries Research Institute has 12 Research Centres and about 30 Field Centres along the coast from where data on exploited marine fishery resources from the artisanal and industrial sectors are being obtained and evaluated. The Institute is advantageously placed that a fund of field data is being collected by the staff for developing proper monitoring of marine living resources. Besides this, we would like other organisations and individuals to cooperate in obtaining as much information on sea turtles for which the NMLRDC would be the repository of data which could be utilised for various purposes. With this in view, the Central Marine Fisheries Research Institute has prepared code number for the five different species of sea turtles for facilitating computer analysis (CMFRI Spl. Publn. No.12). The code numbers are as follows:

Species	Common name	Code
Eretmochelys imbricata	Hawksbill turtle	5101
Chelonia mydas	Green turtle	5106
Caretta caretta	Loggerhead turtle	5111
Lepidochelys olivacea	Olive ridley	5116
Dermochelys coriacea	Leatherback turtle	5121

We would solicit our readers and those who have an opportunity to come across sea turtles to help in developing this national facility and to write to us. It is proposed to bring out with immediate effect in the issues of *Marine Fisheries Information Service, Technical and Extension Series,* a monthly awareness publication from CMFRI, a section on 'Turtle News' indicating field observation made by staff of CMFRI and others with acknowledgements.

The illustrations to help in identification have been taken from published illustrations, such as FAO species identification sheet for Fishery Purposes, Western Central Atlantic (Fishing Area 31), Volume VI, edited by Fischer (1978) and "Sea Turtle Manual of Research and Conservation Techniques prepared for the Western Atlantic Turtle Symposium by Peter C. Pritchard *et al.* (1983) and supplemented by original photographs.

A Key for identification of sea turtles from India

1\. a. Skin smooth and without any scutes on head; 7 longitudinal narrow ridges on carapace and 5 on plastron; horny beak with well defined cusp on each side of upper jaw (beak 'W' shaped when viewed from front) and central cusp on lower jaw; flippers without claws ....*Dermochelys coriacea*

b. Shell, head and flippers covered with scutes; no longitudinal ridges on carapace or plastron; horny beak not 'W' shaped when viewed from front; flippers with one or two claws 2

2\. a. Carapace with 4 pairs of lateral scutes 3

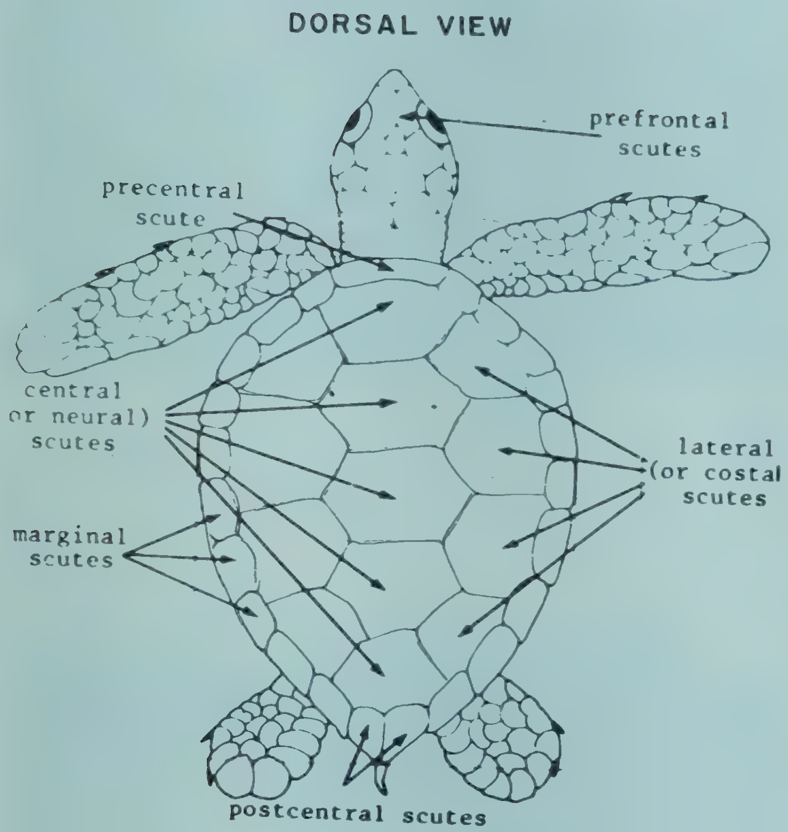
b. Carapace with 5 or more pairs of lateral scutes 4

3\. a. Horny scutes imbricated (overlapping); two pairs of prefrontal scutes; 2 claws on each flipper; carapace is brown with darker markings; skin of neck region pale orange in colour........... *Eretmochelys imbricata*

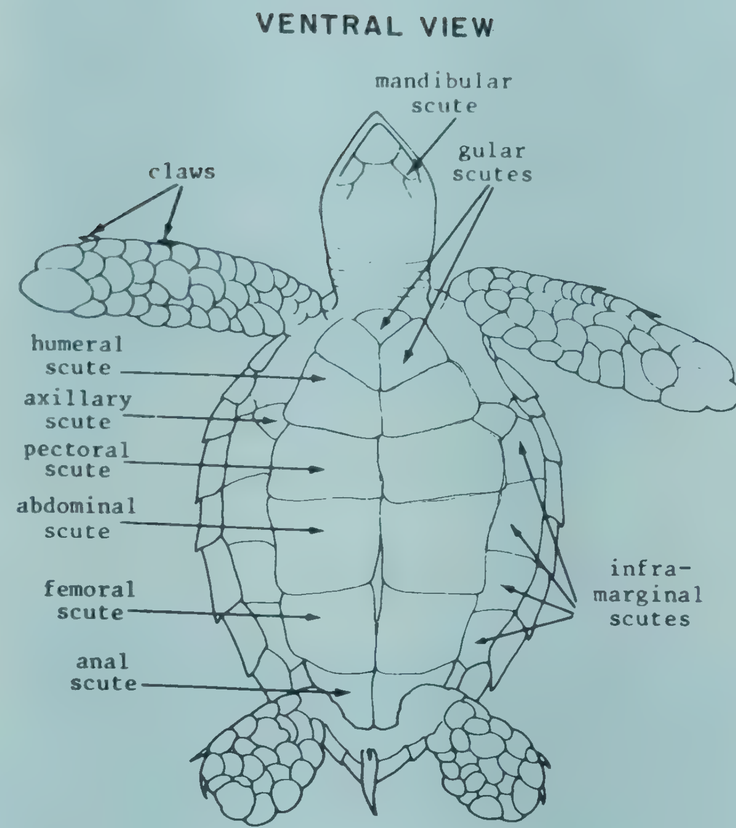
b. Horny scutes not imbricated but juxtaposed; one pair of prefrontal scutes; single claw on each flipper; carapace green with violet markings; skin of neck region yellow to cream in colour .... *Chelonia mydas*

4\. a. Plastron with 3 pairs of enlarged inframarginal scutes without pores; lateral scutes 5; carapace brownish red with light spots and plastron yellow with orange spots .... *Caretta caretta*

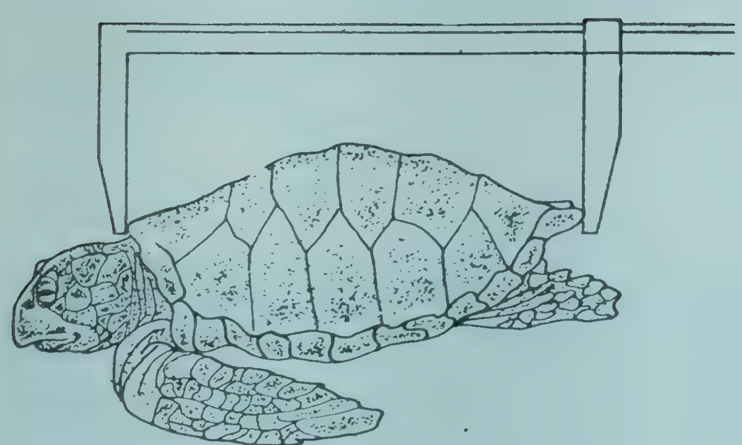
b. Plastron with 4 pairs of inframarginal scutes each with pores on hind margin; lateral scutes 6 or more, generally 7; carapace grey and plastron yellow .... *Lepidochelys olivacea*



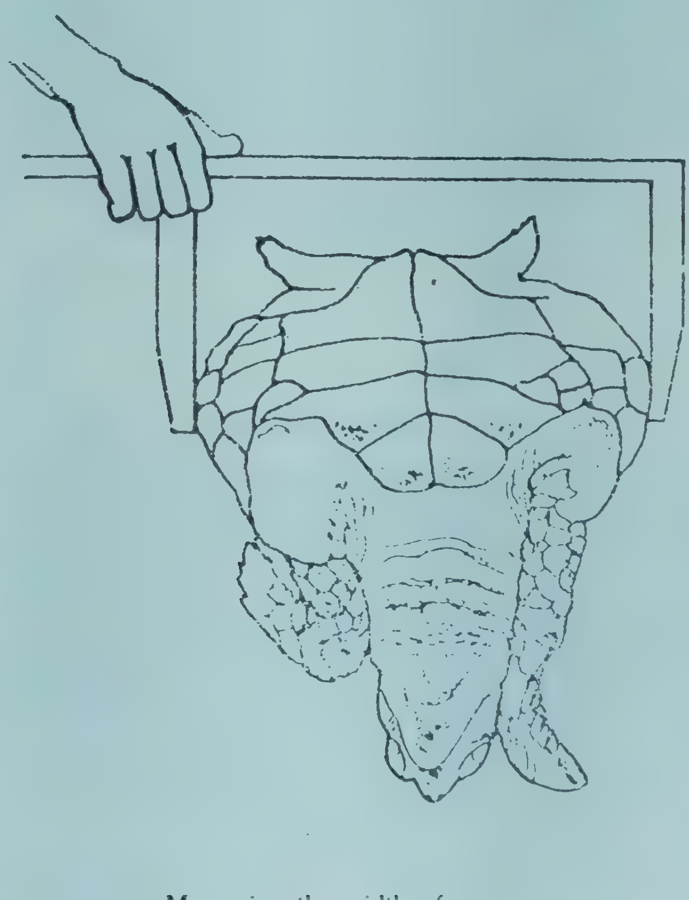
Dorsal view



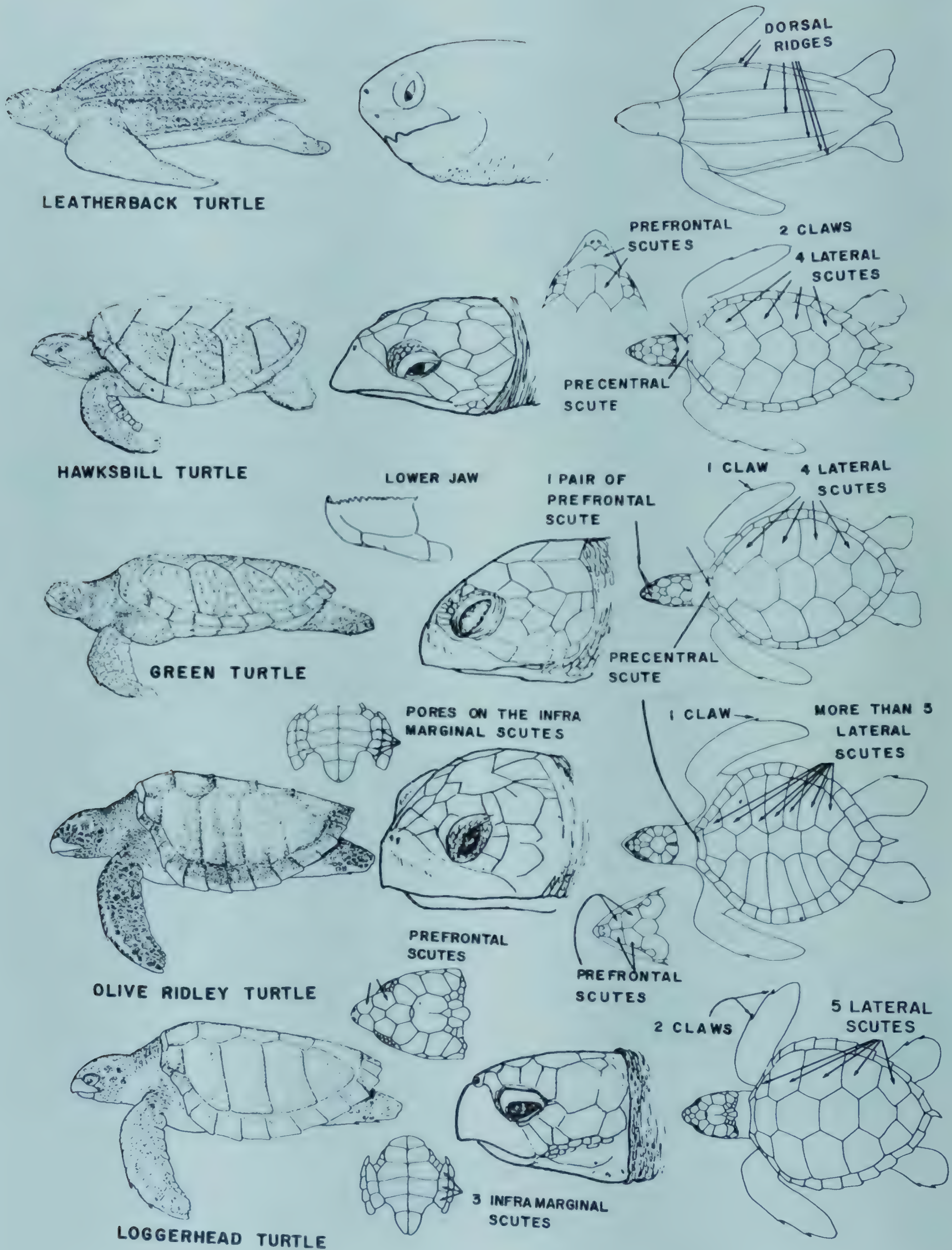
Ventral View



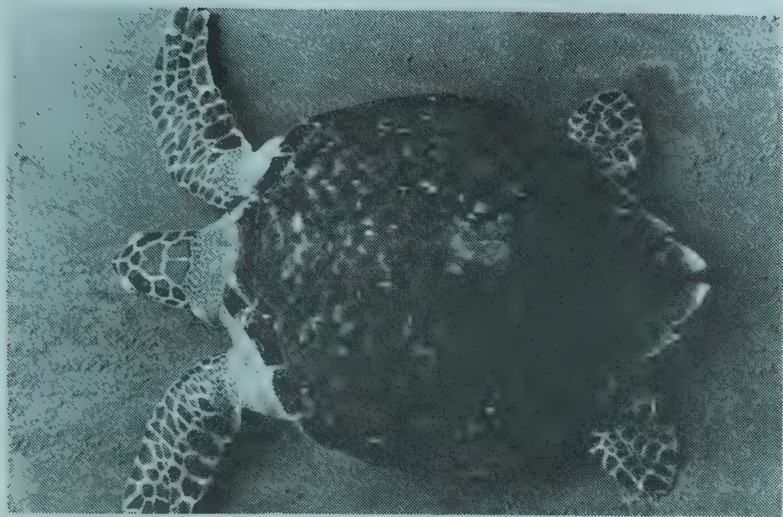
Measuring the length of Carapace

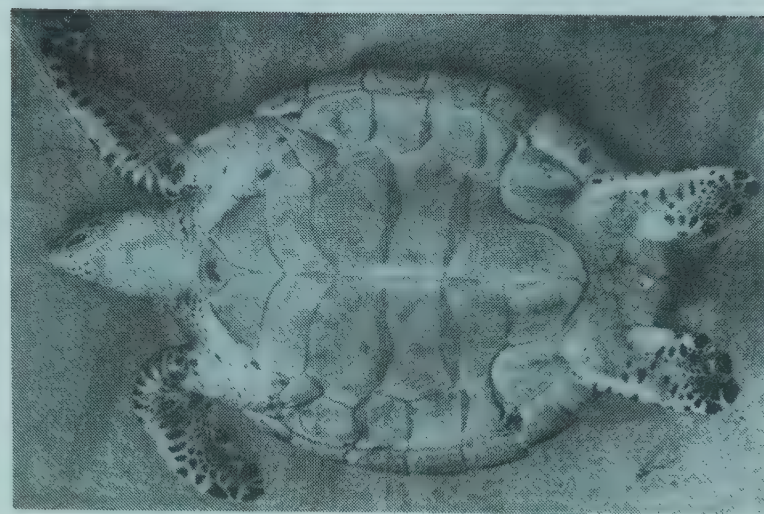


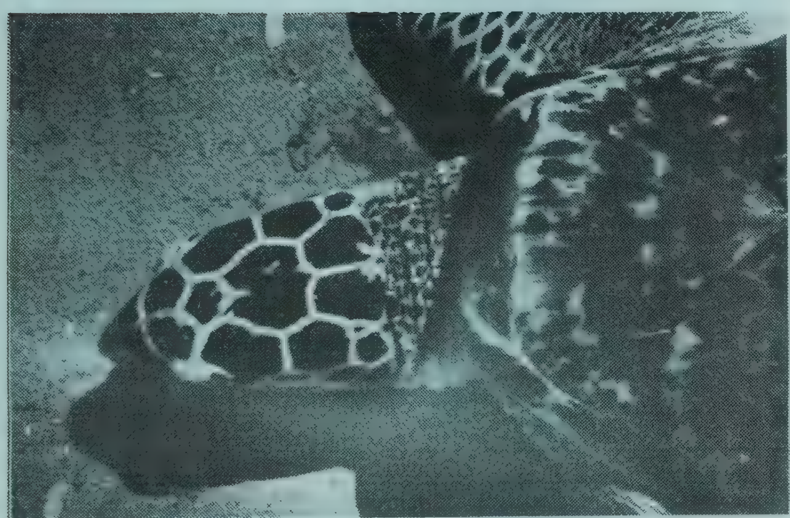
Measuring the width of carapace

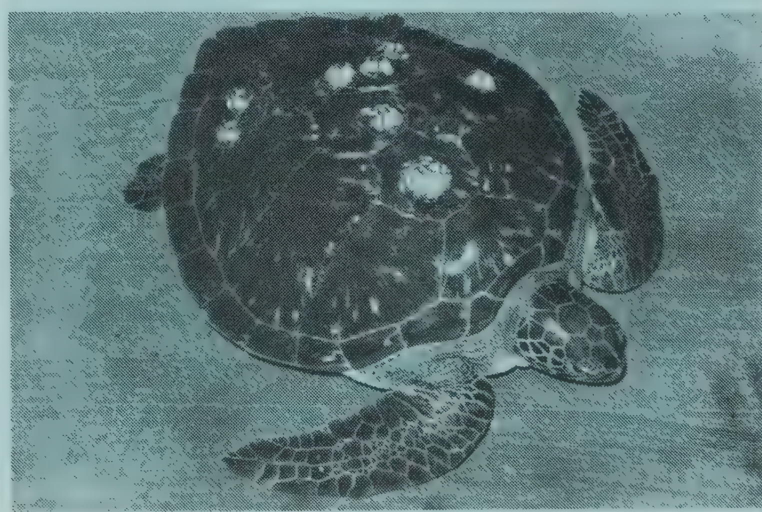


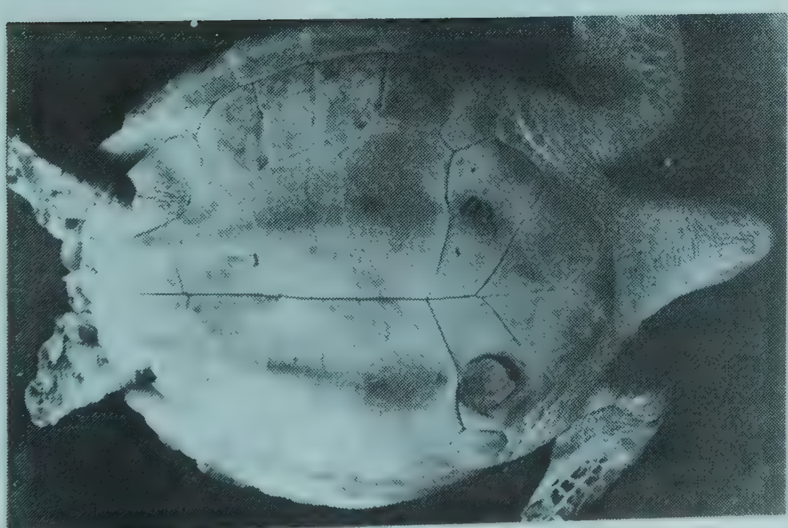
Identifying features of different species.

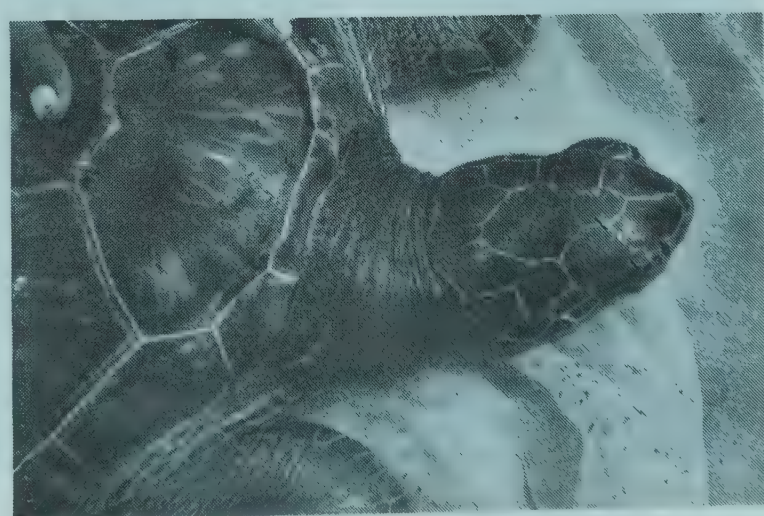

Dorsal view of *Eretmochelys imbricata*

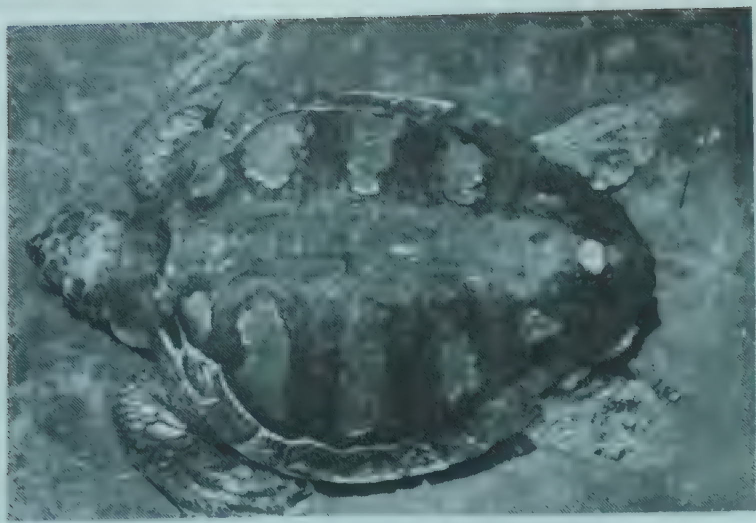

Ventral view of *E. imbricata*


Head of *E. imbricata.*

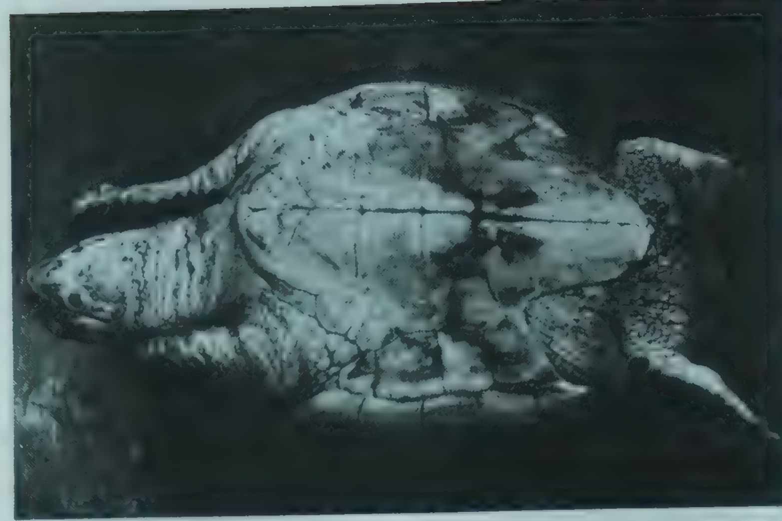

Dorsal view of *Chelonia mydas*


Ventral view of *C. mydas.*

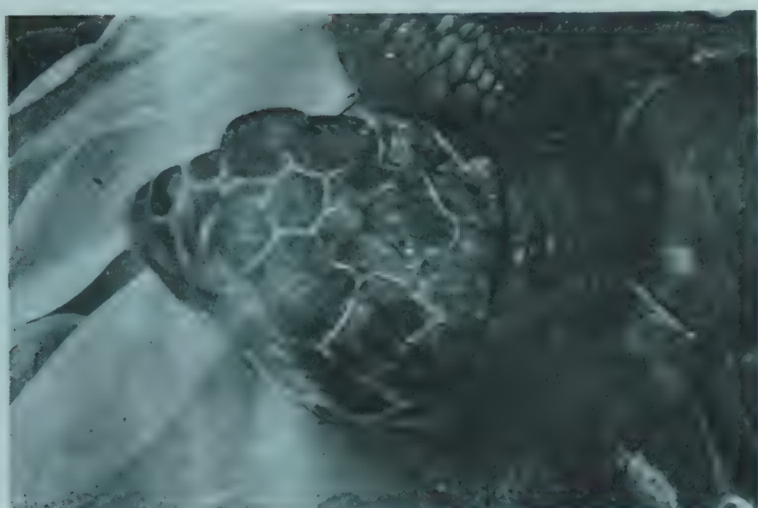

Head of *C. mydas.*



Dorsal view of *Caretta caretta.*

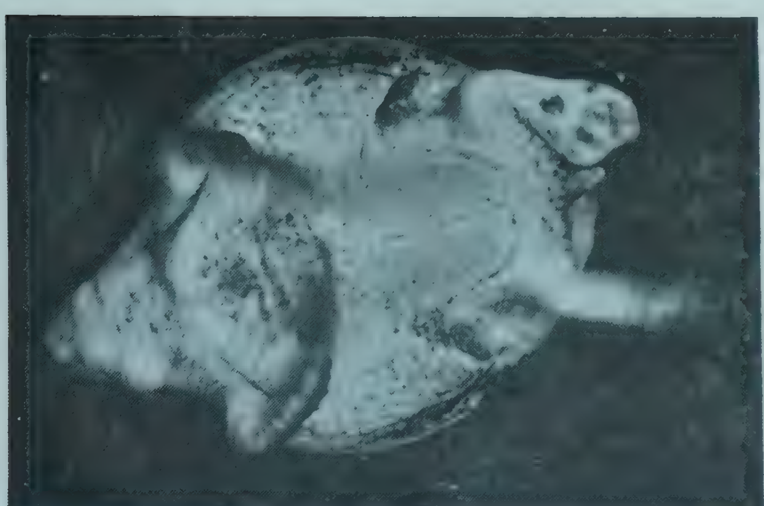


Ventral view of *C. caretta*

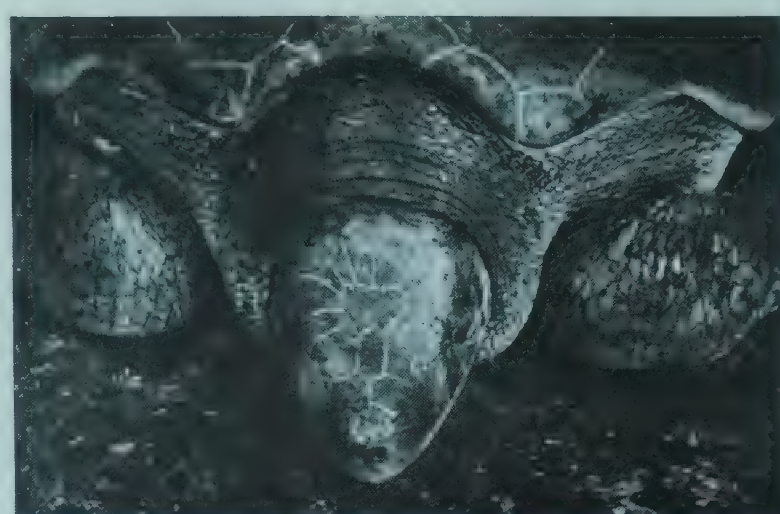


Head of *C. caretta.*

Dorsal view of *Lepidochelys olivacea*



Ventral view of *L. olivacea.*



Head of *L. olivacea.*

Need for a national coordinated programme for studies on sea turtles

A number of governmental and non-governmental organisations are in some way or other involved with sea turtle programmes. We would like to list some of these below:

Central Marine Fisheries Research Institute and its subordinate establishments; Zoological Survey of India; Bombay Natural History Society, Bombay; World Wild Life-India; Snake Park, Guindy, Madras; Forest/Fisheries Departments of Gujarat, Maharashtra, Karnataka, Kerala, Tamil Nadu, Andhra Pradesh, Orissa and West Bengal and Union Territories of Goa, Pondicherry, Lakshadweep and Andaman and Nicobar Islands.

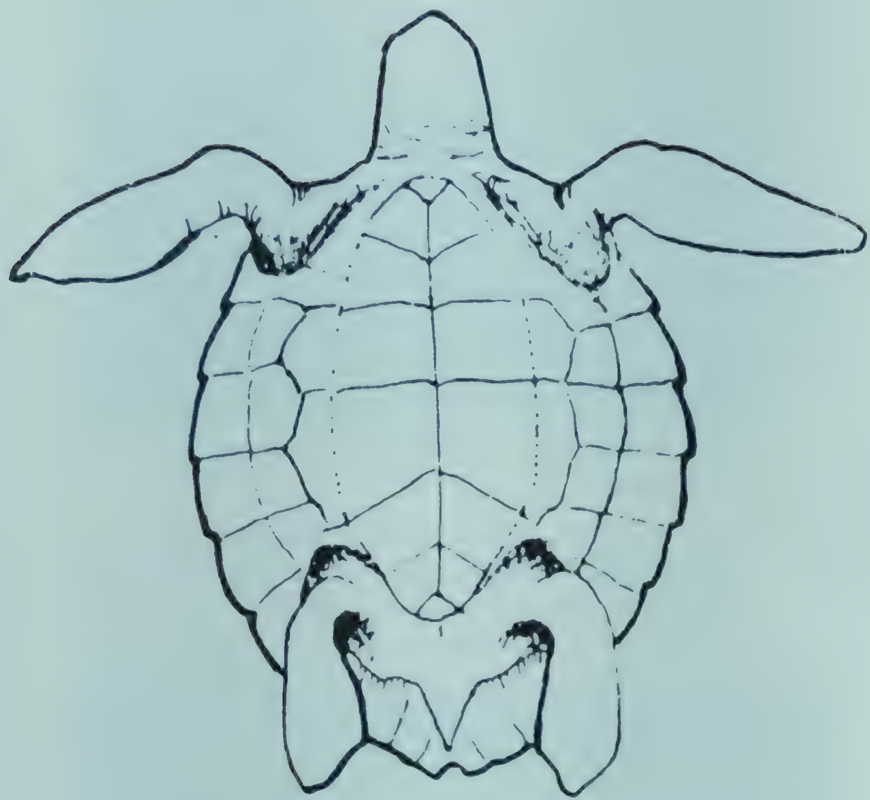
The list may not be exhaustive and we feel that in next few years the sea turtle programme may catch the attention of more organisations and individuals. At the level of Government of India, the Department of Agriculture and Cooperation (Wild Life Protection Section); the Department of Agricultural Research and Education (I.C.A.R); the Department of Environment; the Department of Ocean Development and the Department of Science and Technology have important roles to play.

While our interest in sea turtles is increasing, this should also be linked with a national coordination of the effort being expended. At the same time, a greater awareness on the problem has to be built up in as diverse groups as the artisanal fishermen, industrial fishing sector, officials of Fisheries and Forest Departments for implementing regulation and the public at large. Extension and training are essential components to be integrated in this programme. The identification sheets and the Proformae given in the Annexure will also be printed in regional languages and distributed for strengthening acquisition of data. Recently a trawl net with escape mechanism for allowing turtles to escape from nets (turtle excluder net) has been developed in the U.S.A. The adoption of such nets during the nesting season and trials with such nets to study the economics of the operations for shrimp and other fish forming bycatch need serious considerations. All this call for the active involvement of many agencies and it is felt that such coordinated effort will fructify in developing sound conservation and management measures for sea turtles. It is hoped that this publication will help in the collection of information for baseline studies as well as tackling specific problems.

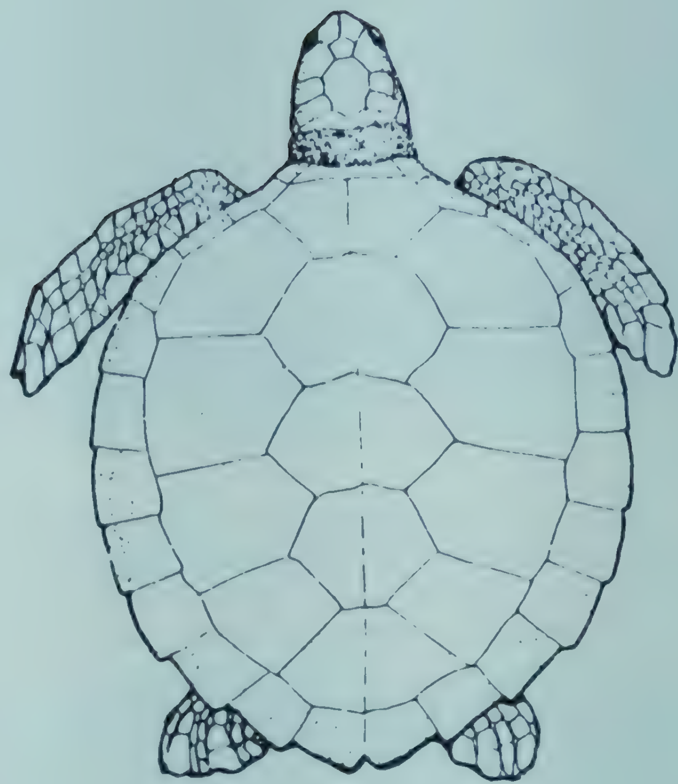
Areas needing priority attention

There is a need for developing a crash programme on sea turtles on scientific lines. This would call for an identification areas for studies and we have tried to identify these here. It is likely that concurrent works may have to be undertaken in some of the aspects detailed below.

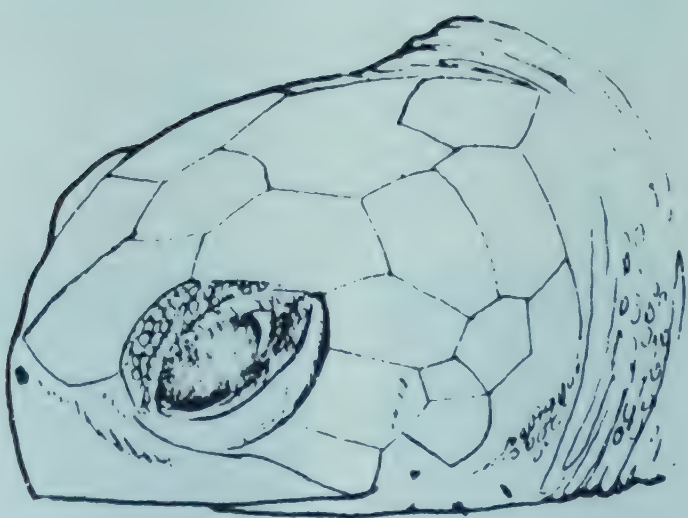
1. Survey of the coast line and Bay Islands for identifying nesting beaches and areas to be protected during the nesting seasons. This will also include demarcation of areas to be developed eventually as reserves where human interference will be minimal and thus affording complete protection to turtles during nesting seasons.
2. Developing a national programme where heavy predation by man and animals on nesting turtles and eggs exists. Hatchery programme for incubating and releasing hatchlings into the sea to improve survival at that stage to enhance possible recruitment.
3. More effective implementation of Indian Wild Life (protection) Act by the State Governments through a programme of training the staff of the concerned Departments in conservation and management of sea turtles and for the implementation of the Wild Life (Protection) Act and regulations.
4. Benign research involving the study of life history, biology and ecology of sea turtles to be carried out with proper dispensation from the concerned authorities.
5. There is a large lacunae in understanding the behaviour of all species of turtles from hatchlings to adults, their migratory habits and movements to and from feeding grounds. This is an area which need important attention.
6. Non-consumptive utilisation of turtle resources so that the relationship between man and turtles could change from killing them for its products to utilize them for educational values, captive and display aspects, recreational/tourist potential, ecosystem concept and so on. There is a great need for creating awareness through proper extension and education programmes on sea turtles among the public.
7. Monitoring of turtles incidental catch in fishing operations and finding ways and means of reducing mortality.
8. An impact study on phasing out subsistence/directed fishery of turtles on the artisanal sector traditionally involved in such activities.
9. Monitoring of the resource to find out whether any of the species could be shifted from Schedule I to Schedule II of the Wild Life (Protection) Act, if sufficient scientific data is forthcoming to indicate the enhancement of resources through proper management measure. This will also have an implication on the CITES convention



Ventral view of *Chelonia depressa* (Flatback turtle)



Dorsal view of *Chelonia depressa* (Flatback turtle)



Head view of *Chelonia depressa* (Flatback turtle)

Species to be on the look out for

Chelonia depressa Garman (Flatback turtle) has been reported from Northern Australia and adjacent waters and its distribution limits are not well defined. The occurrence of this species in the Andaman and Nicobar Islands and along the mainland coast of India cannot be ruled out. Inview of this, the salient features of *C. depressa* along with line drawings to facilitate field identification are given here.

The salient features of *C. depressa* given by Pritchard *et al.* (1983) in the Sea turtle Manual of Research and Conservation techniques, Western Atlantic Turtle symposium are as follows:

"Four pairs of lateral scutes, head upto about 13 cm wide; carapace upto 100 cm long. One pair of prefrontal scutes. Carapace scutes do not overlap, very thin with indistinct margins, especially in adults; dorsal colour yellow grey to grey-green, without spots or radiating markings; underside light yellow; weight upto about 90 kg."

The main difference is that the carapace in *C. depressa* is flatter, more rounded and not tapering behind as in *C. mydas*. The major visual difference between *C. mydas* varies from light tan to almost black above, often with radiant or spotted markings and with underside yellow; while in *C. depressa* the carapace is yellow grey to grey-green without spots or radiating markings, with underside light yellow. *C. depressa* seems to be a smaller species weighing about 90 kg while *C. mydas* weighs upto about 230 kg.

From literature it is seen that the clutch size and size of eggs of *C. depressa* and *C. mydas* differ as follows:

C. depressa	*C. mydas*
1. Average cluctch size about 50 eggs (maximum 73 eggs)	Average clutch size about 85 eggs (maximum 200 eggs)
2. Diameter of egg 5 cm	Diameter of egg 4 to 5.5 cm

C. mydas makes the tracks which are deeply cut with symmetrical diagonal marks made by the front flippers while *C. depressa* makes relatively lightly cut, with symmetrical diagonal marks made by the front flippers.

Confirmatory evidences of the occurrence of *C. depressa* in the Indian seas, including the Andaman-Nicobar Islands, is wanting.

Conclusion

While very dedicated and valuable work has been carried out under extremely difficult and inhospitable conditions along Orissa and West Bengal Coasts by Chandrashekar Kar and other areas by Satish Bhaskar and others the time has come when our efforts should be expended to obtain maximum information in the shortest time possible. The identification sheets and the proformae given in the Annexure which are also to be printed in regional languages for distribution in coastal areas would strengthen the acquisition of data and help to create greater awareness. When turtle tagging programme are undertaken in future wider publicity will be given in coastal areas for recovery of tags/noting of tag numbers and other details during nesting seasons. Adoption of modified fishing gear as the 'turtle excluder net' during the nesting season should be done after suitable trials. It is hoped that this publication will help to accelerate Research and Development programmes on sea turtles and assist in the collection of information for different studies to help and evolve conservation and management strategies for our sea turtles.

NATIONAL MARINE LIVING RESOURCES DATA CENTRE (NMLRDC)

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE, COCHIN-682 018

PROFORMA I

DATA ON SEA TURTLES AT FISH LANDING CENTRES

Species : .... NMLRDC's Code No. ....

Location : .... Sex : ....

Date : .... Dead or Live : ....

Evidence of any previous tag : Yes/No.
If Yes, give details of Tag number, etc : ....

New tag number if tagged
and released : ....

Carapace length (Straight Line) : .... cm Total weight : .... Kg

Carapace width (Straight line) : .... cm

Evidence of any injury : Yes/No. If Yes, give details ....

If incidental catch in fishing gear, type of
fishing craft and gear used : ....

Any turtle trade in that area : Yes/No. If Yes, give details ....

Any turtle egg trade in that area: Yes/No.
If Yes give details : ....

Any incident of turtle poisoning : Yes/No. If Yes, give details ....

Remarks: ....

Investigator : ....

NATIONAL MARINE LIVING RESOURCES DATA CENTRE (NMLRDC)

CENTRAL MARINE FISHRIES RESEARCH INSTITUTE, COCHIN-682 018

PROFORMA II

DATA ON NESTING SEA TURTLES

Species : .... NMLRDC's Code No. ....

Location : .... Sex: ....

Date : .... Time : From ..... To ....

Weather condition : ....

Surf Temperature : .... Sand temperature : ....

Evidence of any
previous tag : Yes/No. If Yes, give details of Tag Number, etc: ....

New tag number, if tagged and released : ....

Carapace length (Straight line) : .... cm Total weight : .... Kg

Carapace width (Straight line) : .... cm

Evidence of any injury : Yes/No. If Yes, give details: ....

If incidental catch in fishing gear, type of
fishing craft and gear used : ....

Surf condition : .... Distance of nest
high water line:............ (m)

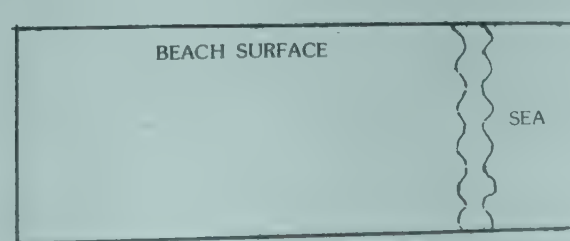
Number of eggs : ....

Any predation of eggs on
nesting beaches : Yes/No. If Yes, give details: ....

Remarks : ....

Investigator : ....

NATURE OF CRAWL (Draw a sketch of crawling pattern in the box)



NATIONAL MARINE LIVING RESOURCES DATA CENTRE (NMLRDC)

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE, COCHIN-682 018

PROFORMA III

DATA ON SEA TURTLES TAKEN AS INCIDENTAL CATCH IN FISHING AND TAGGING OPERATIONS

Species : .... NMLRDC's Code No. : ....

Location : .... Sex: : ....

Date : .... Depth : ....

Time of capture : .... Time of release: ....

Gear operated : .... Depth at which operated : ....

Evidence of any previous tag : Yes/No.
If Yes, give details of Tag number, etc. ....

New tag number, if tagged and released : ....

Carapace length (Straight line) : ......,. cm Total weight : .... Kg

Carapace width(Straight line)........... cm

Evidence of any injury : Yes/No. If Yes, give details: ....

Evidence of any ectoparasite : Yes/No. If Yes, give details :..

Any sighting of mating of
turtles in that area Yes/No. If Yes, give details : ....

Remarks : ....

....

Investigator : ....

MARINE TURTLE CONSERVATION AND MANAGEMENT: A SURVEY OF THE SITUATION IN ORISSA 1981/82 AND 1982/83

E.G. SILAS, M. RAJAGOPALAN, A. BASTIAN FERNANDO and S.S. DAN

Introduction

One of the most spectacular sea turtle activity is the mass emergence (arribadas) of the Olive Ridley *Lepidochelys olivacea* along the north Orissa Coast, more specifically along the Gahirmatha Beach. The unique phenomenon which may or may not occur annually, have been reported by Kar (1980) and Biswas (1982). This is the largest rookery of olive ridley and for that matter, of any species of marine turtle in the world. The mass capture and transport of live olive ridley from the nesting beaches of Orissa and West Bengal to Calcutta and other markets have been reported by Bobb (1982). Such exploitation, despite the endangered status of the species and the protection accorded under the Wildlife (Protection) Act 1972, has attracted considerable public attention and concern for marine turtles at all quarters. Incidental catch in fishing gear also accounts for the death of several hundred turtles during their nesting season. Varied efforts both by the Forest Departments of Government of West Bengal and Orissa and other agencies and individuals, are under way to study these problems.

Programme at the Central Marine Fisheries Research Institute

The CMFRI has also developed a national programme for :

1. surveying and demarcating nesting grounds of marine turtles along the Indian Coast and the Bay Islands;
2. monitoring incidental catch of turtles in fishing operations and finding ways and means of minimising the same;
3. developing hatchery and hatchling release programme;
4. carrying out tagging of turtles to understand their population structure, migratory habits, growth, longevity and mortality rates;
5. investigating biological aspects and behaviour of turtles; and
6. strengthening the National Marine Living Resources Data Centre (NMLRDC) for the acquisition and dissemination of data on marine turtles from our Exclusive Economic Zone (EEZ).

Nesting ground survey

Valliappan and Whitaker (1974) and Whitaker (1977) gave an account of Olive ridley of the Coromandel Coast and Biswas (1981) gave an account of olive ridley of Bay of Bengal, identifying some of the nesting beaches. Bhaskar (1981) in a preliminary report, has indicated the important nesting beaches of sea turtles along the Indian Coast and the Bay Islands. He (Bhaskar, 1983) also reported the nesting beaches of the leatherback turtle in the Andaman Islands. It is proposed to map all this information so as to make it available for further consideration towards taking conservation and management measures for protecting the nesting beaches especially during the nesting seasons (Fig. 1).

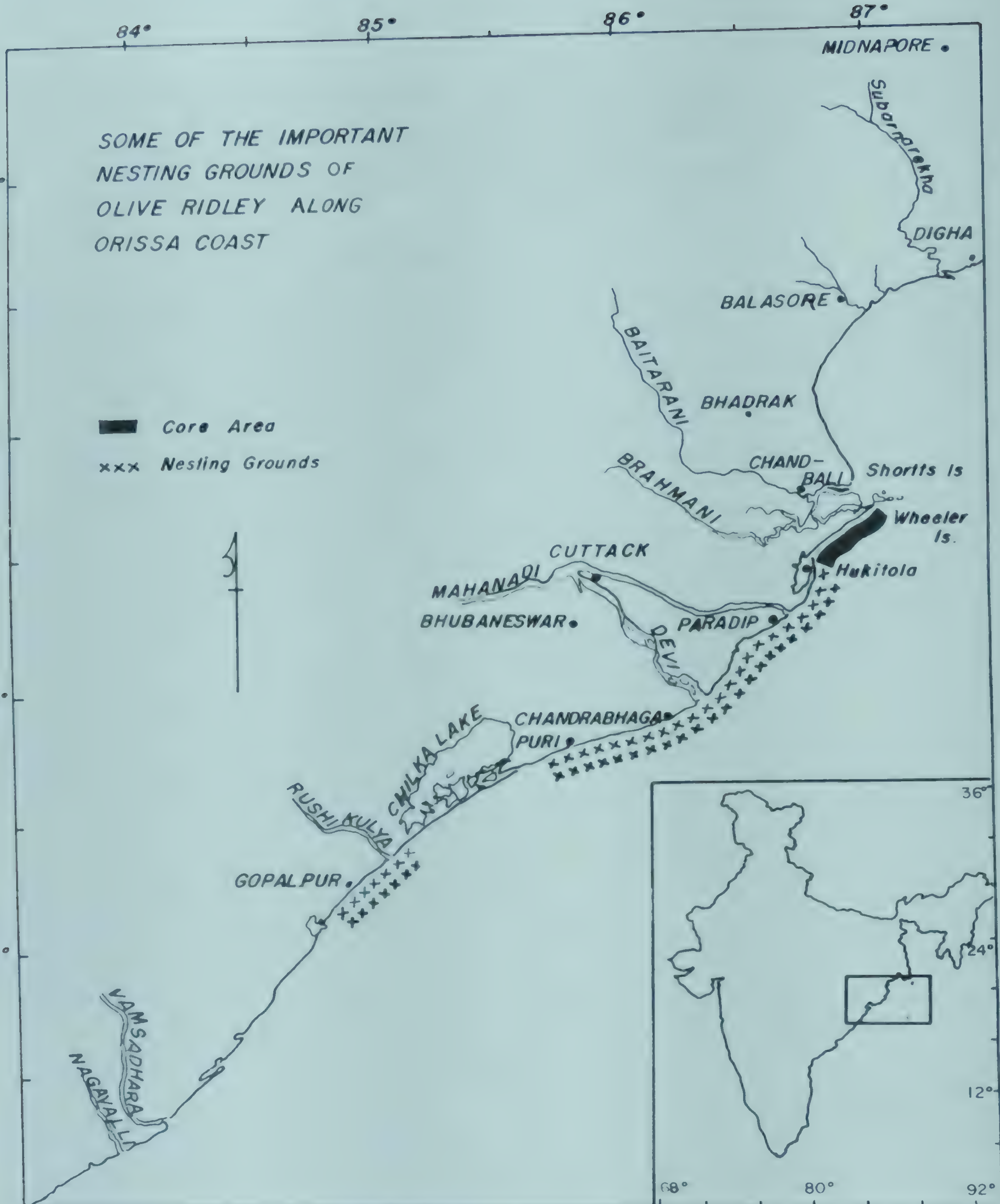
Gahirmatha sea turtle rookery 1981/82 and 1982/83 season

For earlier accounts of the nesting habits and intensity of breeding activity of the olive ridley reference is invited to Bustard (1976), Biswas *et al.* (1977), Davis *et al.* (1978), Kar (1980, 1982), Biswas (1981) and Kar and Bhaskar (1982).

In view of the importance of the nesting grounds of olive ridley along the Orissa Coast, teams from CMFRI have been sent to the area in 1981–82 and 1982–83 seasons to study the situation and evaluate the options open for evolving in the future management strategies. It is proposed to outline here the factual information gathered from different locations along the Orissa Coast.

1981/1982 season

During the 1981–1982 season, turtle landing centres, such as Pentakotah, Astrang, Chandrabagh, Nuagoda and Paradeep were visited by the team. In order to collect information on the landings and transport of turtles, officials of the Departments of Fisheries, Forest and Railways were contacted. Official attempts have been under way by the State Forest Department to effectively enforce the Wildlife (Protection) Act from October 1977 for marine turtle protection. Prior to the Wildlife (Protection) Act coming into force, Pentakotah was the main fishing centre for sea turtles and from there during the season, around 2000 turtles used to be sent to Calcutta market where the meat was sold at the rate of Rs. 6 per kg. In the 1981 season, there was



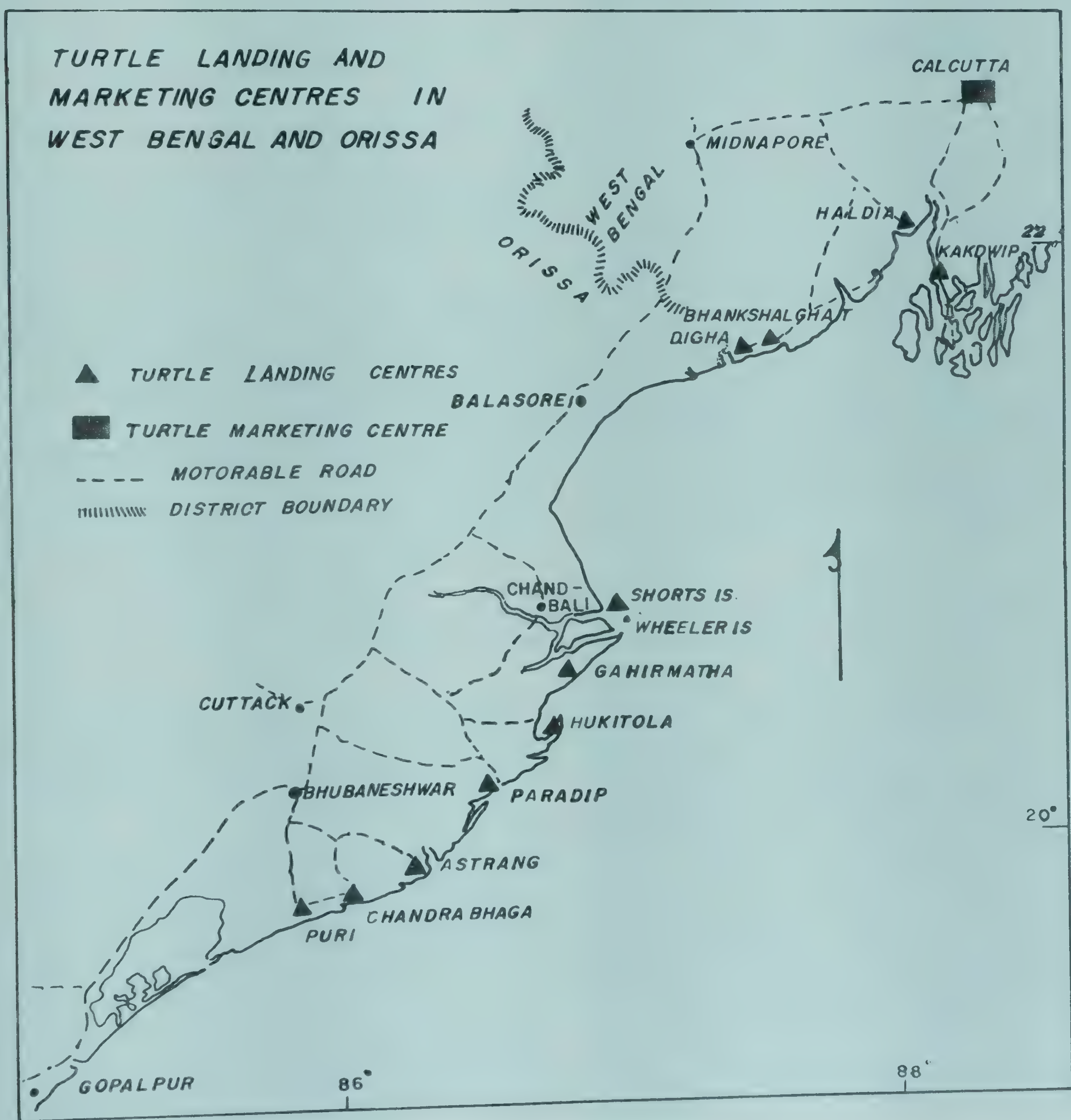
no fishery at all due to the ban imposed and enforced by the Forest officials of the Government of Orissa. The South Eastern Railway authorities also refused to book the turtles for transportation by train from Puri to Calcutta. There is no market for sea turtles in Orissa State. Some of the fishermen seasonally operating along the Orissa Coast hail from East Godavari District of Andhra Pradesh and due to religious taboo, turtle meat is not consumed by them. In fact, the turtle is venerated as according to Hindu belief, it is the second incarnation of Lord Vishnu (in the form of turtle He was born 'Koorma avathar').

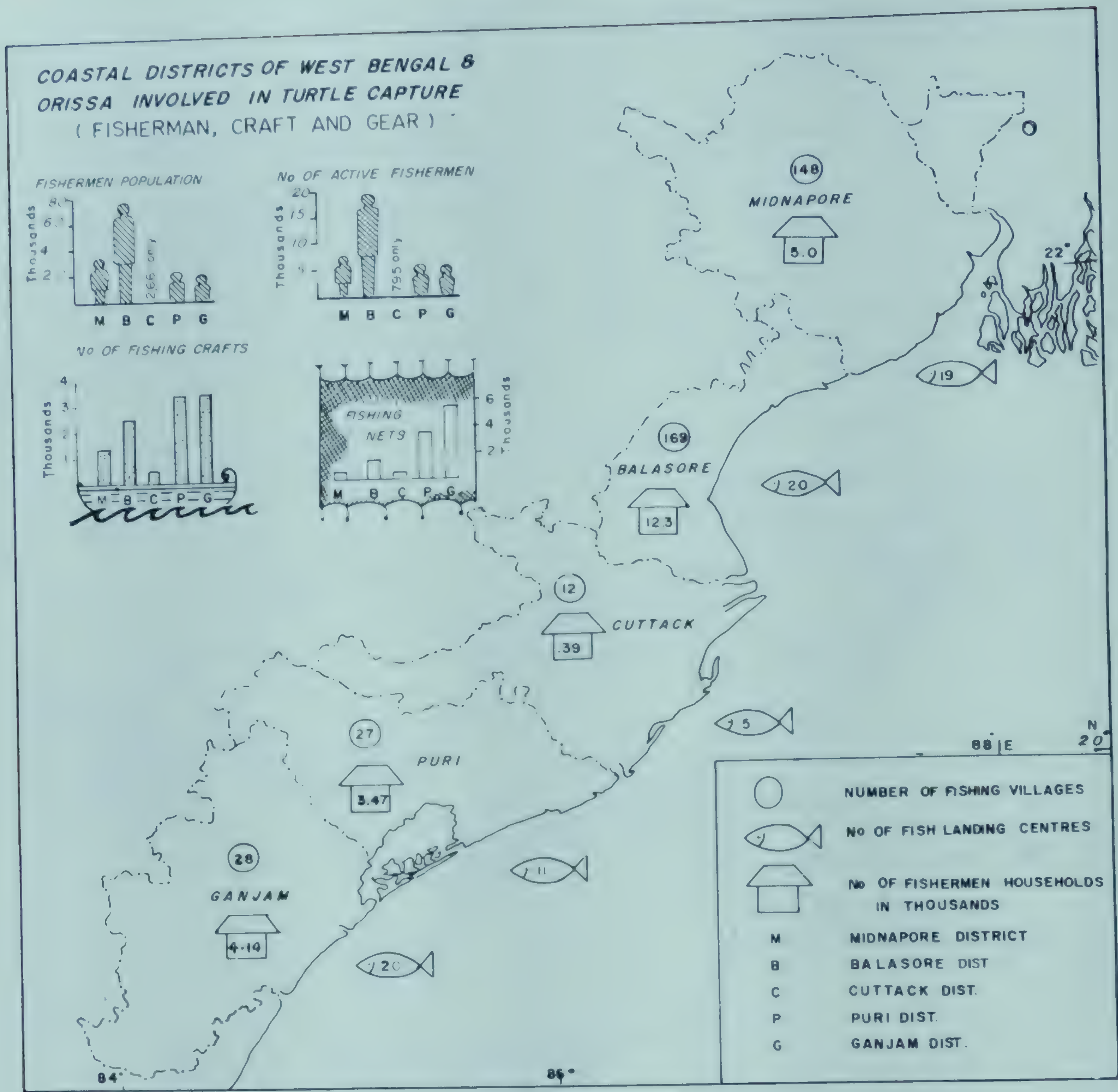
Pilfering of fish from Railway wagons has been a matter of routine. Live turtles were transported in trains without being confined to cages. On one such

fish pilfering spree, it is said that an employee of the Railway Department accidently stepped on the back of a turtle which quickly snapped at his foot and relieved him of two of his toes. Due to this incident the Railway authorities later insisted for proper caging of turtles for booking. As this would unreasonably increase the cost, there was reluctance and lack of interest on the part of traders to fabricate cages for transport. Besides, the price of turtle meat was hardly Rs. 6 per kg in the Calcutta markets and the cost at the landing site, hardly Rs. 15 to 20 per turtle. The investigations indicated that as late as in 1981, transport of turtles by Railways from Orissa to Calcutta was in vogue.

Fishery of the past

During the heyday of the fishery in the late seventies, no special turtle nets were used. The fishing season was from the second fortnight of October to the first fortnight of February. Turtle fishery was always a supplementary one. Gill nets with 70 mm mesh size were used for fishes such as seer fish, pomfrets and other pelagic fishes. These nets are used at different depths in the water column by changing different types of sinkers and floats. Fishermen in this area use catamarans and Kakinada type boats. During mating, the turtles are extremely sluggish and they are easily hauled aboard by hand or they were easily encircled with





nets and trapped without causing any damage to the nets. Usually during the mating season, turtles were caught in pairs. However, merchants preferred female turtles and males were generally released back into the sea. Illegal transport from landing centres by road to Calcutta and adjacent markets (Fig. 2) needs checking.

Status of the turtle fishery, 1981-82

Except at Pentakotah and Astrang turtles entangled in fishing nets are nowhere landed now. At each of these villages on an average one or two turtles are brought ashore per day. Only a few fishermen, if at all they do, eat turtle meat and as there are no buyers (a turtle fetching hardly Rs. 5 to 10) often they are released back into the sea. This has been witnessed by CMFRI team when they visited these villages. It was estimated that about 12 to 15 turtles were landed per week at Pentakotah and 4 per week at Astrang. In other landing centres, since they are operating small meshed drift nets for sardines, the incidental catch of turtles is extremely rare.

Another important fact is that the fishermen are fully aware of the ban imposed and exercised by the Forest Department. The officials of the Fisheries Department are more preoccupied with culture fisheries and execution of economic plans concerning the upliftment of the impoverished artisanal fishermen of Orissa, leaving the turtle protection to the Forest Department. An anomolous situation prevails, where the Department of Forest and not the Department of Fisheries is empowered to control a resource that is

caught in the sea. The extent to which this would be a constraint for the development of proper management measures is yet to be seen.

In the recent past, the chief poachers of turtles have been the fishing vessels from Thailand and Taiwan. The CMFRI team met a number of skippers of Indian fishing vessels both at Paradeep and Vizagapatnam. They confirm that the area north of Gopalpur is a mating ground of turtles, and during mating, the turtles are remarkably sluggish. Males are often seen in fewer numbers than females, one male often favouring many females. During the mating season, the fishermen from foreign vessels (it is reported that atleast 70 vessels can be sighted in a day on the prawn fishing grounds close inshore) scoop off from the surface turtles methodically, while they fish for prawns from within our territorial and contiguous continental shelf waters.

Railway officials are unable to provide any data on the numbers of turtles carried by their wagons because almost all the turtles booked in the Railways were simply categorised as 'fish' since the turtles were not properly caged and as fish carried lesser freight rates.

1982/1983 Season

The 1982-83 season brought to light a very significant event along the Orissa Coast where exceptionally large number of dead turtles in various stages of decay were found along the Gahirmatha Beach during the first week of March 1983. This was undoubtedly the result of 'incidental catch' from fishing gears operated from mechanised and non-mechanised fishing crafts. The remains of nylon webbing around the neck and flippers of many of the carcasses are ample testimony to what happened prior to the visit of the team from the Institute. Another sad fact noted from the carcasses was that animals were mutilated before disentangling them from nets as evident from deep gashes on the head and parts of the body.

Kar (1980) indicated that incidental catch accounted for about 500 olive ridley along the Gahirmatha Beach area and opined that 'this of course represents a tiny fraction of the actual offshore catch'. His suggestion in this context is very pertinent and we would endorse the same for enlarging the limits of the Bhitarkanika Wild Life Sanctuary limits northwards to include Wheeler and Short s Islands and southwards to include Hukitola Island and the beaches upto Paradeep, as the olive ridley is known to often congregate in large numbers along inshore waters off these beaches for nesting. Besides, a seasonal restriction in the fishing activity using certain types of gears such as wide meshed gill nets would be imperative. This along with a clearly demarcated inshore area should afford protection to the turtles from fishing activity during the mating season. A "turtle excluder" net for shrimp trawling has been developed in the U.S.A. and trials with similarly designed trawl nets should be undertaken to see its efficacy in allowing turtles to escape while fishing selectively for shrimp from mechanised boats in our coastal waters. We feel that unless urgent action is taken in regulating or adopting new modifications in fishing gear, the nesting beaches along Orissa Coast may turn to be indeed the grave yard - the largest graveyard of olive ridley - anywhere in the world.

Observations at Gahirmatha turtle rookery

The CMFRI team vistied the Bhitarkanika Wild Life Sanctuary and specifically Gahirmatha to study the nesting beach conditions. Gahirmatha Marine Turtle Research and Conservation Unit was established in 1976 and the detailed studies on the nesting conditions of olive ridley was reported by Kar (1980). During the 1982-'83 season from 3rd to 9th February mass nesting of about 200,000 olive ridley turtles was reported (Courtesy: Orissa Forest Department).

In the first week of March 83, thousands of dead turtles strewn on a stretch north of Gahirmatha Beach was noticed. The numbers varied from 55 to over 150 per 100 metres of stretch of beach (average 59 turtles-/100 metres). It was estimated that around 7000 to 7500 dead turtles were strewn along the stretch of 15 km at Gahirmatha a true 'grave yard' for turtles. The details of measurements in cm of dead turtles based on measurements of several dozens are as follows:

Carapace length 51-72 (62.2)	Carapace width 48-63 (57.8)
Plastron length 44-57 (51.8)	Plastron width 43-53 (49.3)
Head length 18-23 (20.9)	Head width 12.5-14.5 (13.6)

In addition to dead turtles, about 6 beaked dolphins were also noticed in different stages of decomposition, off Gahirmatha Beach along a stretch of 7.5 km. The details of measurements in cm are as follows:

Total length (to fork of tail fluke)	170-286
Tip of snout to flipper origin	32-35
Tip of snout to dorsal origin	76-105

The dead turtles and dolphins, both endangered species were the result of incidental catch in gill net fishery as evidenced from pieces of net-webbing on the animals.

Predation by wild animals

Heavy predation on the eggs of olive ridley especially by jackals, wild boars, hyaena, dogs and other wild animals was noticed. They also create extensive damage to the nests, destroying not only the fresh ones, but the 5 to 15 days old nests as well. The predation was noticed mainly very near the mangrove areas.

Fish landing centre at Chandpali.

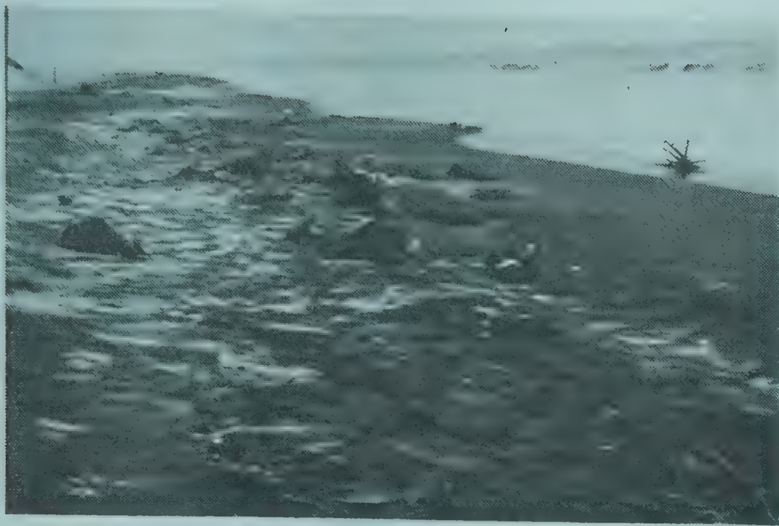
Fishing harbour at Dhamra.

Fishing harbour, Paradeep

Landing centre at Gahirmatha.

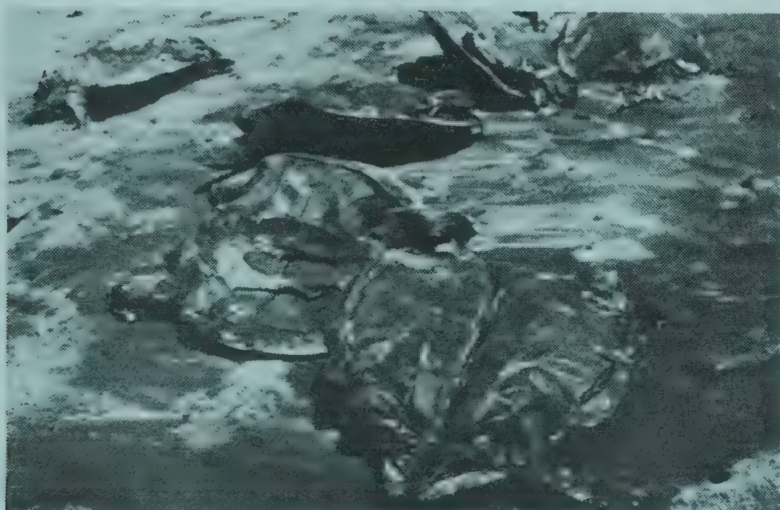
Bhitarkanika sanctuary creek during low tide.

Bhitarkanika sanctuary creek during high tide, an approach to Gahirmatha.



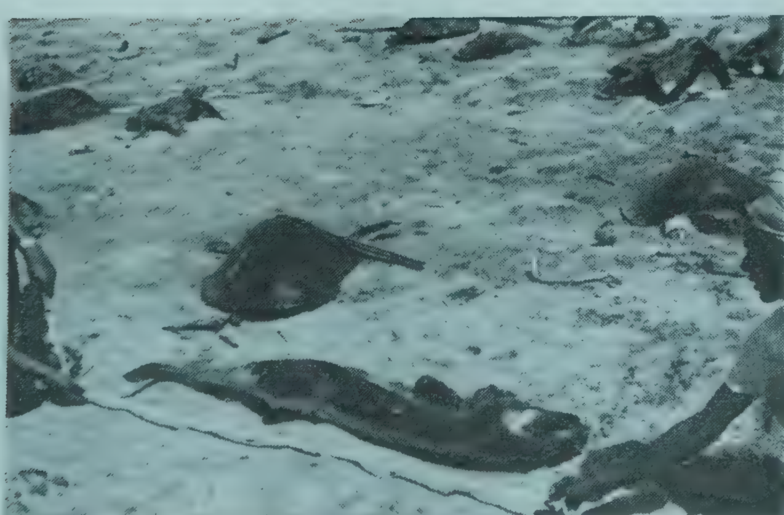
Carcasses of olive ridleys washed ashore along Gahirmatha Beach

Carcasses strewn along Gahirmatha Beach



Close up view of dead turtles at Gahirmatha.

Dead turtles (olive ridley) along with decomposing dolphin at Gahirmatha Beach



Collection of data on dead turtles and dolphins by CMFRI team.

Dead turtles washed ashore near Gahirmatha Turtle Research and Conservation Centre, Orissa Forest Department.

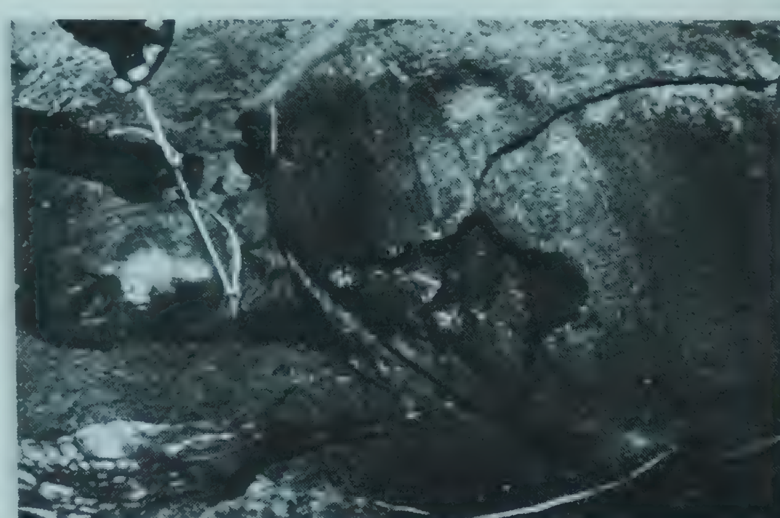
Remnants of cyclone affected mangrove at Gahirmatha.

Uprooted mangrove stumps for use as fuel at Gahirmatha a potential danger inviting sea erosion.

Broken egg shells of olive ridley predated by wild animals immediately after nesting.

Predation of eggs near mangrove area, Gahirmatha.

Carcasses of beaked dolphin at Gahirmatha.



Piece of gill net around the neck of an olive ridley.

The damage was noticed upto 10 metres inside the mangrove area. The pugmarks of wild animals were seen in the mangrove area and upto the level of high water mark along the beaches.

Since predation is heavy and also the possibility of damage to earlier nests by subsequent nesting turtles due to pressure on the restricted nesting grounds, it is imperative that hatchery programmes for collecting the eggs, incubating them, releasing the hatchlings from the same beaches should be organised.

Need to preserve the mangrove

Erstwhile coastal mangrove vegetation said to have been destroyed earlier by cyclone is today indicated by mere stumps. The removal of stumps from the area may be fraught with increasing erosion of the beach and this should be prevented. Efforts to replant mangrove along the coast as a conservation measures should be given priority consideration.

Prevention of poaching of turtles

The problem faced by the forest officials is prevention of poaching by fishermen in the sea. The help of the Coast Guard was sought. During the year 1981-82 season Coast Guard vessels 'Rajhansa' and 'Rajtarang' patrolled between Paradeep to Dhamra area to prevent turtle poaching in the sea. During the 1982-83 season, Coast Guard vessel 'Rajhansa' patrolled coastal waters from Paradeep to Dhamra on 6th and 7th February '83. Since the mass emergence 'arribada' occurred at Gahirmatha from 3.2.'83 to 9.2.'83 the patrolling by Coast Guard vessel was very effective in preventing poaching. With their help, the Orissa Forest officials on 6.2.'83 seized 3 trawlers and 10 country boats with gear and arrested 32 persons belonging to West Bengal. The arrested persons were produced before the Judicial Magistrate at Kendrapara, Orissa.

The alert action taken by Forest Department officials needs appreciation. Here we reproduce extracts from the Press with English translation which should be of interest (Appendix I to III).

Fishermen population and infrastructure facilities

For any management strategies to be developed for conservation and management of turtles, it is essential that we have information on the existing infrastructure which has a direct link with resource. Here fishermen population along the coastal villages and their fishing craft and gear and marketing facilities should be known. The Central Marine Fisheries Research Institute has collected valuable information of the coastal fishermen population, craft and gear, village-wise, household-wise in Orissa and this information is summarised here. It is felt that this would be useful in planning any regulartory measure in fishing activities.

The number of marine fishing villages in Orissa State is 236, the maximum being Balasore District (169) and fewer in Cuttack (12). The number of fish landing centres in the State is 56 and of which 36 are in Balasore District.

Of the total 20,329 number of marine fishermen households, 61% of fishermen families is in Balasore and 17% in Puri and 2% in Cuttack Districts. The total fishermen population in the state is 1.17 lakhs and 64% are from Balasore District and 18% from Puri and 2% from Cuttack. The number of fishermen engaged in actual fishing in Orissa is about 30,724 forming 26% of the total fishermen population. In Balasore District the percentage of fishermen engaged in full time fishing is 62 and the part time and occasional being 23 and 15 respectively. The percentage of fishermen belonging to full time category in Cuttack District is 55, part time being 44 and occasional 1. The number of mechanised boats owned by fishermen is 106, all these being gill netters from Balasore District. The total number of non-mechanised crafts is about 10,000 and of this Puri District has 34% and Balasore District has 25%. Catamarans constitute the largest number of non-mechanised crafts (64%) followed by plank built boats (34%) and dug out canoes (2%). In Balasore District, plank built boats constitute 96% and in Puri District catamarans constitute 84% of non-mechanised crafts. Details of figures of marine fishing villages and fishermen population of Balasore, Cuttack and Puri Districts are given in

Table 1. *Details of marine fishing villages and fishermen population in Orissa 1980*

	Balasore	Cuttack	Puri
Number of villages	169	12	27
Number of landing centres	20	5	11
Number of fishermen households	12316	393	3472
Fishermen population:			
a. Male	24145	886	6733
b. Female	20963	728	6119
c. Children	29410	1047	7888
Total	74518	2661	20740
Educational Status:			
a. Primary	6119	25	1180
b. Secondary	1362	2	545
c. Above Secondary	215	—	118
Total	7696	27	1843
Number of fishermen engaged in actual fishing:			
a. Full time	11539	442	4938
b. Part time	4204	349	643
c. Occasional	2766	4	417
Total	18509	795	5998

Table 2. *Mechanised and non mechanised fishing crafts and gears in Orissa 1980*

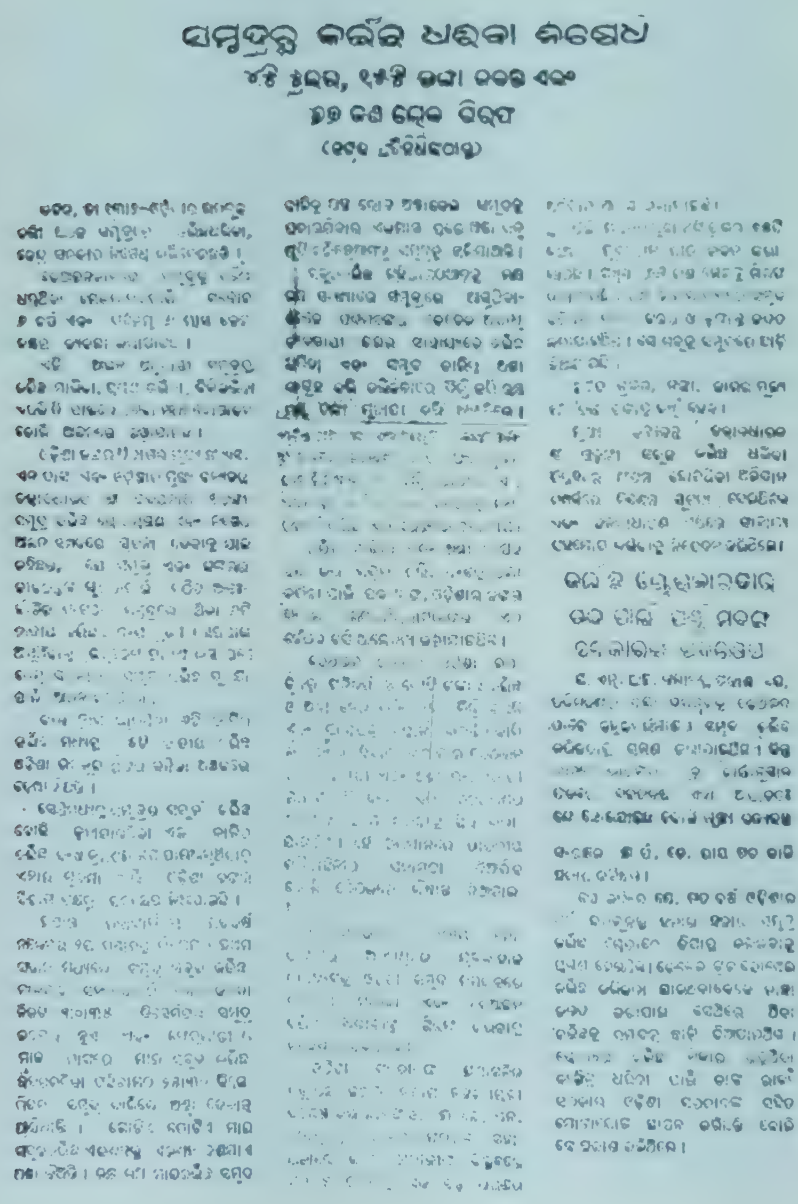
Number of fishing crafts	Balasore	Cuttack	Puri
a. Mechanised			
Gill netters	106	—	
b. Non mechanised			
Plank built boats	2324	218	475
Dug out canoes	103	—	76
Catamarans	1	228	2831
Other	4		
Total	2432	446	3382
C. Number of fishing gears			
Drift/Gill nets	1702	425	2782
Boat seines	141	19	1467
Fixed bag nets	2507	198	1
Hooks and lines	212	242	10688
Shore seines	2475	—	58
Traps	492	23	—
Scoop nets	14	—	—
Others	4575	4	13

Table 1 and the details of figures of marine fishing crafts and gears of the three districts are given in Table 2

General remarks

The 'turtle problem' along Orissa Coast calls for an integrated crash programme of conservation and management to be developed in the shortest time possible. This may have to be given a national priority in our programmes on the conservation and management of living marine resources. Since the inputs have to come from different agencies, a coordination body or cell will have to be constituted to discuss with specialists and planners for a long term programme for the area. The major initiative has to come from the Department of Environment of which Wild Life Protection is also a part.

APPENDIX I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(ଆମ ପ୍ରତିନିଧିଙ୍କଠାରୁ)

APPENDIX II

'The Samaj' Oriya daily published from Cuttack-1 dated 15.2.'83

Capture of turtles in the sea is prohibited

4 trawlers, 15 country boats seized and 66 persons arrested. (From Cuttack representative)

Cuttack Dated 13th Feb. '83

The Central Government has banned the capture of sea turtles from Orissa Coast. An imprisonment upto maximum of 6 years and minimum of 6 months has been provided in the law for the turtle poachers. Capture of sea turtle from the sea and also its transport, sale and keeping them in custody is banned.

The Additional Chief Conservator of Forests, Orissa Forest Department Sri. S.N. Das and the Chief Wildlife Warden Sri. U.N. Sarangi said that the Central Government has enforced the wild life protection act on marine turtles after the International Organisations expressed concern about the possible extinction of six varieties of turtles available in the sea. Out of six endangered species of turtles five are found near Bhitarkanika area.

One of the varieties, known as Olive Ridley turtle is facing the possible extinction and hence the Forest officials have taken steps to protect them. Every year these olive ridley turtles of the Pacific Ocean found to float in the sea water upto 30-35 km off Bhitarkanika for mating and the period is form 2nd week of November to 1st week of December and during February and March female olive ridely turtles lay eggs in the sand at Gahirmatha covering the area of 25 to 30 km beach.

One female turtle lays 100-110 eggs at a time. Lakhs of such turtles lay eggs in the sand and after one month the hatched out young ones go back into the sea. Some dishonest businessmen from West Bengal have been making huge profits by catching of lakhs of turtles from the sea using trawlers and collecting eggs from the beaches. Turtle meat (flesh) and eggs are served as costly items in big modern hotels in Calcutta. Apart from this, export of turtle meat to foreign countries is a profitable business.

To save the progeny of the olive ridley turtle, capture of turtle and collection of turtle eggs are prohibited and the officials of Government of West Bengal and Orissa meet together in the arranged meeting and discussed about the steps to be taken for protecting the marine turtles.

It was estimated that the turtle meat and eggs worth 4 crores of rupees was sold every year in Calcutta markets and also exported to foreign countries. For the protection of marine turtles in the sea, help of Indian Navy was sought. The Central Government had instructed to use the most modern ship 'Rajhansa' to maintain vigilance in Orissa Coast and to arrest people engaged in illegal fishing. The officials of forest department, Orissa especially Sri. L.N. Chowdheri, Divisional Forest Officer raided the poachers on 5.2.'83 with the help of police.

By noon 4 trawlers and 15 country boats with costly nets were seized. Altogether 66 persons were arrested. Thousands of turtles were seized from them.

The cost of country boats and trawlers is above 18 lakhs.

The Chief Wildlife Warden Sri. Sarangi appealed the public to cooperate in the protection of marine turtles.

The steps taken by West Bengal Government to prevent poaching of turtles

U.N.I. report: According to Sri. P.K. Roy, Chief Wildlife warden, large number of turtles used to be transported to Calcutta markets from Digha. But due to stern action taken by the Government this has come to an end. Last year thousands of turtles captured in Orissa Coast were landed at Digha and transported to Calcutta markets. This year some turtles which were transported from Digha were caught on the way and released back into the sea. West Bengal Government is regulary contacting the Orissa Government and steps are taken to arrest the persons engaged in this illegal business.

APPENDIX III

THE TIMES OF INDIA, MONDAY, DECEMBER 6, 1982 7

Turtle poaching causes concern

BHUBANESWAR, December 5 (UNI).

LARGE-SCALE poaching of the Pacific Ridley sea-turtles (Lomep Idachelys Olivacea) and wanton destruction of their nests by various beach predators has caused concern to the government

According to an Orissa forest department report, these oval-shape, olive-green creatures which form an endangered species used to migrate in large numbers from the Pacific Ocean to the shallow waters all along the eastern coast, especially the high sand dunes interspersed by forests, creeks and nullahs between the mouth of the Maipura river and Hagirmatha, and the adjacent Wheeler and Shorts islands near the Bhitar Kanika Crocodile Sanctuary in Cuttack district.

Though preliminary studies in 1976 revealed that their courting and mating usually takes place during October-December when a large number of copulating pairs can be seen floating near the rookeries on the beach, little is known about their migratory routes, food habits, life circle and other data necessary for formulating a scheme for their preservation and scientific examination.

The report points out that a large number of hatchlings which fail to enter the sea before dawn are preyed upon by thousands of migratory sea gulls and other birds and mammalian predators like wild boars, dogs, jackals, hyenas and panthers.

Poachers in big groups from Digha in West Bengal and Balasore in Orissa also catch thousands of sea-turtles by nylon nets in violation of the Wild Life (Protection) Act, 1972 and sell them mainly in the Calcutta market.

The adults and their eggs are also collected by the poachers from the rookeries on the beach and trawlers which go sea-fishing in the vicinity of the breeding ground, causing accidental killings.

The department has suggested a scheme to regulate such fishing activities especially during the peak mating and nesting season, and transplanting of the nests to protect the hatchlings from high-tide flooding.

It has also suggested more scientific research on their behaviour pattern, protection in their natural habitat and proper exploitation of the surplus turtles and eggs without affecting the population.

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MARINE TURTLE CONSERVATION AND MANAGEMENT: A SURVEY OF THE SITUATION IN WEST BENGAL 1981/82 AND 1982/83

E.G. SILAS, M. RAJAGOPALAN and S.S. DAN

Introduction

In spite of the promulgation of the Indian Wildlife (Protection) Act 1972 and the protection accorded to sea turtles, fishermen and traders from West Bengal and Orissa have been carrying trade on turtles resorting to poaching from the inshore fishing grounds along Orissa-West Bengal, not sparing the turtles even during mating season off Gahirmatha, Orissa State. However, during the last two seasons, the West Bengal and Orissa Forest officials have taken constructive steps, though inadequate, to prevent turtle poaching and marketing. To create public awareness the regional and national dailies have been publishing articles on sea turtles with a stress on conservation.

Turtle poaching at various centres

Midnapore District, West Bengal

The fishermen from Midnapore District used to arrange organised capture of marine turtles from the fishing grounds of Orissa. During 1981-82 season it was estimated that 15 fishing units, each unit comprising of a motor launch with 6 country crafts were deployed from Digha. Each unit captured about 6000 numbers during the season. During the 1982-83 season the scale of poaching of turtles was reduced to a great extent due to the vigilance by the Forest officials. It was estimated that from mid-December 1982 to end of February 1983 about 10,000 live turtles were clandestinely landed at Bhanshalghat from where they were transported to Calcutta and Tatanagar for marketing. Thus, the 1982-83 season saw a reduction in the catch by almost 90% over the previous season.

At Digha

On 14th and 15th December 1982 a team from Central Marine Fisheries Research Institute visited Digha and adjacent areas to study the situation. On 15.12.'82 at the Digha fish landing centre, live olive ridley were detected in two sheds. The first shed was located on the western side of the landing centre, where 34 turtles (14 males and 20 females) were kept. The second shed was located on the eastern side of the landing centre where 25 live turtles (10 males and 5 females) were dragged along the beach and kept for transport to the market.

The turtles measured (in cm)

Males :	Carapace length 67-72	Carapace width 56-68
	Plastron length 50-54	Plastron width 42-50
Females :	Carapace length 65-69	Carapace width 54-64
	Plastron length 49-59	Plastron width 40-54

The live turtles weighed between 30 to 40 kg and was for sale by the fishermen to the traders at the rate of Rs. 40 to 50 per animal at the landing centre.

On the same day, Sri. A.K. Basu, Forest Beat Officer, West Bengal Forest Department on a surprise inspection of this centre, confiscated the 59 turtles from the two sheds and arranged for their release into the sea. At Digha beach, on 15.12.1982 in a two km stretch more than 12 dead turtles were noticed. Dogs were eating the flesh from the carcasses which had been freshly washed ashore, apparently 'drowned' as a result of entanglement in the gill nets operated along the coast.

When the team visited Digha on 1st February 1983, 11 live turtles tied by ropes and 57 dead turtles strewn along a 3 km stretch of Digha Beach were noticed. The latter were undoubtedly part of the incidental catch in the gillnet fishery and were discarded in the sea by fishermen and washed ashore, while the live ones were brought to shore in boats for trade. The team visited Digha again in the last week of February '83. At that time neither live turtles nor freshly washed ashore dead turtles were noticed. About 25 decomposed carcasses of olive ridley were seen at the landing centre of which 9 were seen with their flippers tied together with nylon ropes. The measurement in cm were as follows:

Carapace length 57-67 (63.0)	Carapace width 48-61 (57.1)
Plastron length 48-58 (54.1)	Plastron width 45-52 (47.0)

On 20th February '83 at Digha Muhana landing centre, the team noticed about 15 carcasses of olive ridley of which five had their flippers tied together with nylon ropes. The measurements in cm of the specimens were:

Carapace length 63-71 (66.7)	Carapace width 53-65 (58.6)
Plastron length 55-61 (58.3)	Plastron width 48-53 (48.7)

At Bhankshalghat

Bhankshalghat is located on the banks of a creek 20 km away from Digha and 7 km to the interior from sea coast. Due to the vigilance of the forest offcials at Digha, the fishermen resorted to transporting the turtles to Bhankshalghat during nights through the creek in boats and from there to Calcutta by trucks. On 19.12.'83 the team observed 15 fresh carcasses of male and female olive ridley at Bhankshalghat measuring (in cm):

Carapace length 59-70 (64.2)	Carapace width 49-64 (57.7)
Plastron length 49-59 (57.1)	Plastron width 45-51 (47.5)

As already mentioned, during 1982-83 season Bhankshalghat was the most active centre for this nefarious trade. The possibility in future of turtles being transported through the creeks to landing centres in the interior cannot be ruled out.

Turtle sale at Calcutta markets

As a result of the preventive measures taken by Orissa and West Bengal Forest officials during the 1982-83 season the number of turtles transported to Calcutta markets had diminished to a few thousands from about 90,000 to 100,000 during the previous season.

Date	Place	Number of olive ridley noticed in Calcutta markets
20.12.1982	Howrah	165
22.12.1982	Shealdah	58
23.12.1982	Howrah	134
7. 1.1983	Howrah	35
13. 1.1983	Howrah	27
24. 1.1983	Howrah	50

The weight and selling price of turtles varied from 30 to 45 kg and from Rs. 110 to 160 per turtle respectively.

The West Bengal Forest officials were also active in booking offences under the Act of illegal transport of turtles. On 21st December 1982, a truck which was transporting turtles was caught near Narghat and the vehicle and the persons involved were produced before the Subdivisional Judicial Magistrate, Contai. In this case, 90 turtles were recovered and they were released back into the sea at Junput. Totally three such offences were registered against transport of turtles by the West Bengal Forest officials at the Subdivisional Magistrate court, Contai between 17.12.'82 and 28.12.'82. This action no doubt had some deterrent effect but the effort will have to be vigourously pursued in future with wider publicity on conservation programme on turtles to make the system more effective.

Table 1. *Details of marine fishing villages and fishermen population in Midnapore District, West Bengal*

Number of villages	148
Number of fish landing centres	19
Number of fishermen households	5028
Fishermen population	
a. Male	11442
b. Female	9515
c. Children	12970
Total	33927
Educational Status	
a. Primary	7112
b. Secondary	1351
c. Above Secondary	116
Total	8579
Number of fishermen engaged in actual fishing	
a. Full time	6034
b. Part time	2114
c. Occasional	265
Total	8413

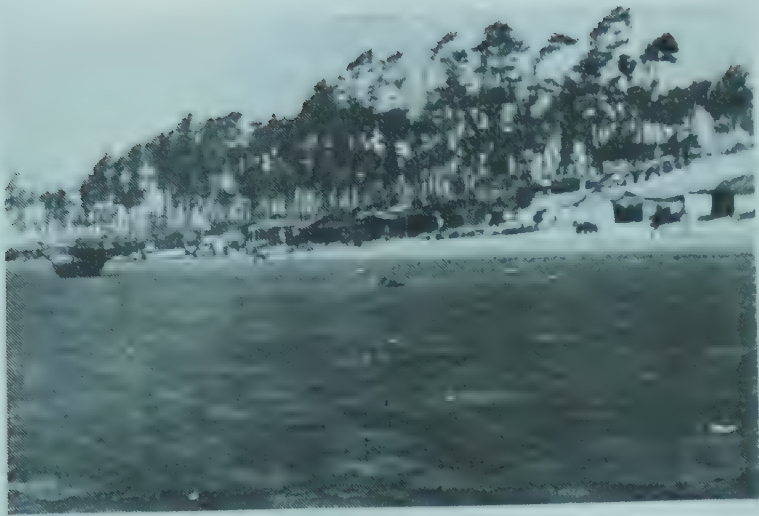
Table 2. *Mechanised and non-mechanised marine fishing crafts and gears in Midnapore District, West Bengal*

Number of fishing crafts:	
Mechanised gillnetters	57
Others	15
Total	72
Non-mechanised	
Plank built boats	1130
Dug out canoes	2
Total	1132
Number of fishing gears:	
Drift/Gill nets	437
Fixed bag nets	2752
Hooks and lines	60
Shore seines	97
Scoop nets	82
Others	1864

Fishermen population and infrastructure facilities

In the All India census conducted during 1980 by CMFRI, information on the fishermen population and the infrastructure facilities available in the major fishing centres along West Bengal Coast has been collected and is briefly as follows.

The six districts of West Bengal comprise 303 fishing villages and most of them (148) are in Midnapore District. Fishermen from Midnapore District operate their boats along the Orissa Coast. The total number of fish landing centres in Midnapore District is 19. Of the 14000 fishermen households the maximum number (35%) is in Midnapore District. The total sea going fishermen population in West Bengal is about 84000 of which Midnapore District accounts for 41%. The number of fishermen engaged in actual fishing forms 24% of



Fish landing centre, Digha a noted place from where hundreds of turtles used to be sent to Calcutta market

Ice packing of fishes to be transported to Calcutta market

Gill nets being dried at Digha fish landing centre

Fishing canoes at Digha fish landing centre.

Fishing trawlers at Digha Muhana fish landing centre

Fish landing centre, Bhankshalghat 7 km from the sea, from where truck loads of turtles used to be sent by road to Calcutta market.

Temporary shed for the olive ridley at Digha fish landing centre for illegal transport to Calcutta market as on 15.12.1982.

Easy way of transporting from fishing boats to turtle shed by cycle rickshaw, the hard beach surface facilitates this transport.

Turtles being lifted bodily from rickshaw to the shed.

Turtles being dragged from the rickshaw to the shed.

Scene of turtles kept supine in the shed enclosure.

Turtles awaiting transport at the beach


One more turtle shed at the western side of Digha fish landing centre located on 15.12.'82.


Plight of protected turtles in the hands of illegal traders.


Timely and prompt check by Forest officials of Govt of West Bengal.


Turtles being carried as head load to be released back into the sea.


Olive ridley on way back to sea owing to the vigilance of forest officials of West Bengal.


Release of olive ridley in the presence of CMFRI and Forest Department officials.

Sign board at Forest Department office, Contai notifying Wildlife Protection Act.

Dog licking the blood of freshly washed ashore olive ridley at Digha Beach.

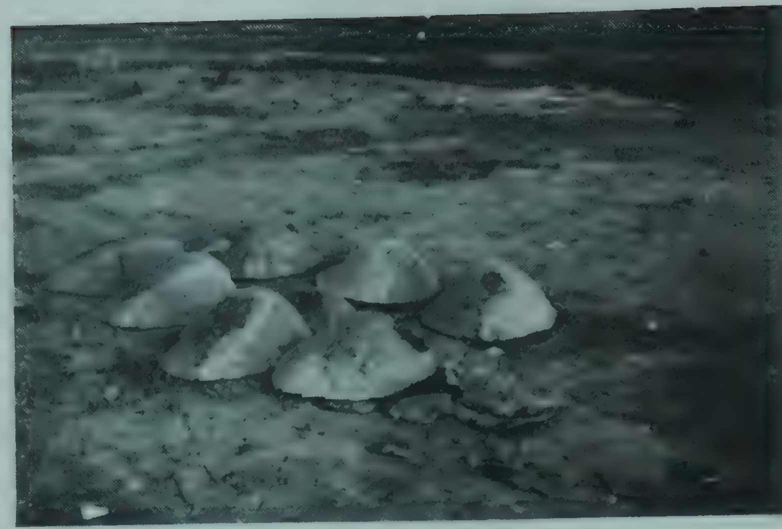
Turtle washed ashore at Digha fish landing centre.

Dogs feeding on the carcasses at Digha Muhana fish landing centre.

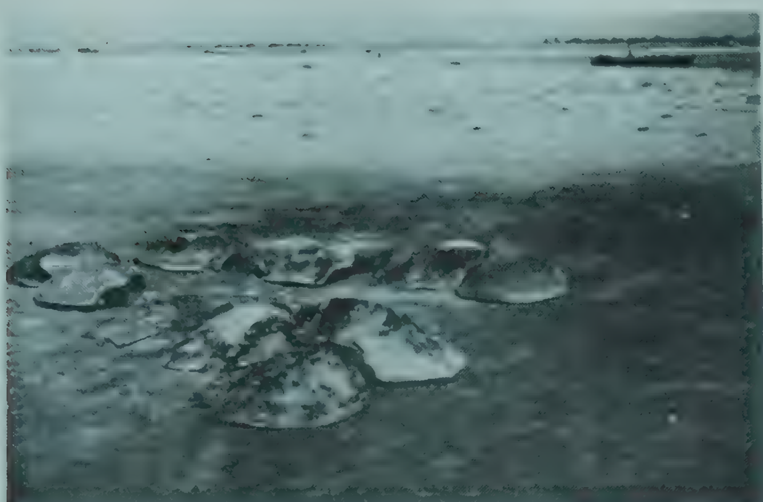
At Digha fish landing centre.

At Bhankshalghat.

Discarded carapaces of olive ridley seen during the last week of February '83 at Bhankshalghat.



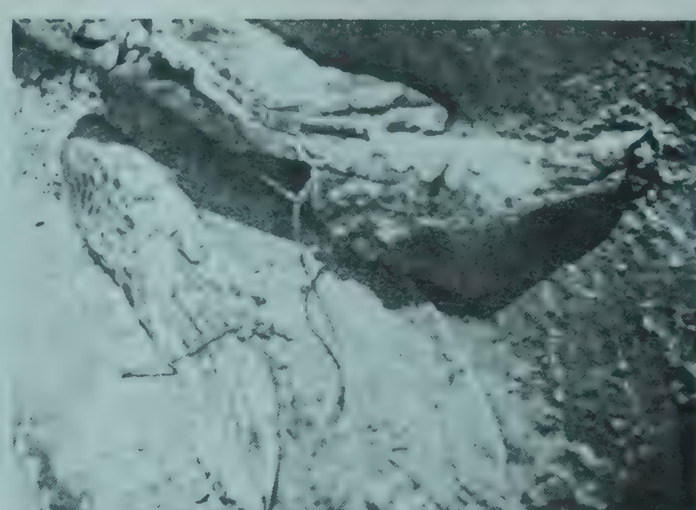
Remains of carapaces at Bhankshalghat - remainder of 1982-83 season.



Carcasses at Digha Muhana seen during the last week of February '83.

Carcasses at Digha fish landing centre.

Remains of nylon rope around flippers and carapace to help transport of turtles from Gahirmatha to Digha.



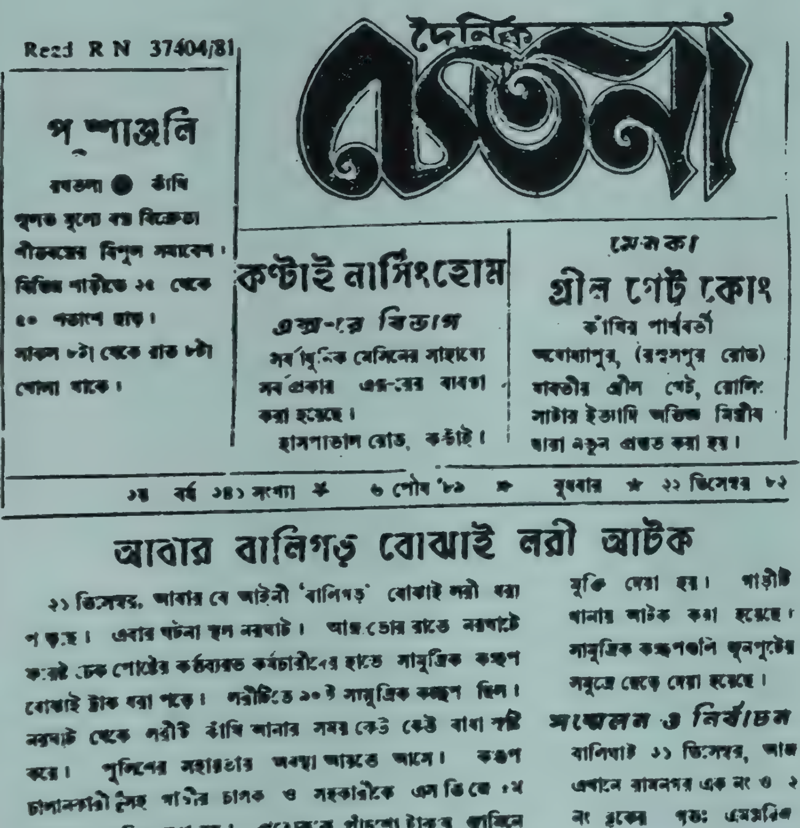
Close up view of flippers tied with nylon rope at Digha.

the total fishermen population. In the Midnapore District as much as 72% of the fishermen engaged in actua fishing belong to the full time category and only 25% come under the part time category.

In this State the number of mechanised crafts owned by fishermen is 310. Out of this, gillnetters constitute 80%. The number of mechanised boats in Midnapore District is 72. Gillnetters form the maximum number (57), there being only 15 carrier boats. Midnapore District has 28% of the 4100 non-mechanised boats recorded in West Bengal. Of the 6200 fixed bag nets recorded in West Bengal 44% is found in Midnapore and of the 2500 drift/gill nets 18% are recorded from Midnapore. Details of marine fishing villages and fishermen population of Midnapore are given in Table 1 and the details of marine fishing crafts and gears in Midnapore are given in Table 2.

The information on the census of fishermen and craft and gear should enable an objective regulatory programme to be developed in case any restriction on fishing activity is contemplated. Any such action should not affect the artisanal fishermen for whom alternate seasonal avenues of work and source of income may have to be properly planned. This will call for a special study of the artisanal fisheries of this particular area extending From Midnapore Coast in West Bengal to Paradeep in Orissa. The CMFRI is already aware of this problem and is initiating a survey to be followed up later by a more detailed study of the socioeconomic aspect of the artisanal fisheries and the impact of cessation of the seasonal turtle fishery along the coast.

APPENDIX I


দৈনিক চেতনা
আবার বালিগড় বোঝাই লরী আটক

"DAINIK CHETANA" dated 22.12.1982

(Bengali Daily published from Contai)

Lorry loaded with sea turtles is seized again

Dated 21st Dec. 1982

Again a lorry illegally loaded with sea turtles is caught. Now the place of incidence is Narghat.

Today early in the morning a truck loaded with sea turtles was caught at the Forest Department Check Post by employees on duty. There are 90 sea turtles in it. Some people created objections when the lorry was brought to Contai from Narghat. The situation came to control after the arrival of police officials. The transported turtles along with the driver and his assistant were produced before the Subdivisional Judicial Magistrate, Contai. The driver and his assistant were released on bail after the payment of Rs.500/-. The vehicle was seized and the sea turtles were released back into the sea at Junput.

দৈনিক চেতনা

বালিগড় এখনো ধরা হচ্ছে

২ জানুয়ারী, শৌলা, হরিপুর, পুরুষোত্তমপুর, জুনপুট ও বাঁকশাল প্রভৃতি ঘটিতে সরকারী বিধি নিষেধ অগ্রাহ্য করে এখনও বালিগড় ধরা হচ্ছে। বাঁকশালে এক ব্যবসায়ী গোপনে বালিগড় চালান দিতে গিয়ে কয়েকবার ধরা পড়েছে। এ বিষয়ে স্থানীয় পুলিশ প্রশাসনকে জানানো সত্ত্বেও কোন ব্যবস্থা গৃহীত হয়নি বলে প্রকাশ।

"DAINIK CHETANA" dated 3-1-1983

(Bengali Daily published from Contai)

Sea turtles are being caught even now

Dated 2nd Jan. 1983.

Even now sea turtles are being caught at Saula, Haripur, Purushottampur, Junput and Bankshalghat by defying Government ban. A businessman was caught several times during his attempt to transport sea turtles secretly. It is reported that no action is being taken by local police although they have been informed.

দৈনিক চেতনা

না দেখলে বিশ্বাস করা যাবে না

পুষ্পাঞ্জলি

কলকাতা ● কাঁথি

সুলভ মূল্যে বস্ত্র বিক্রেতা: কাশ্মীরী শালের বিপুল সমাবেশ। বিভিন্ন শাড়ীতে ১৫ শতাংশ ছাড়।

সকাল ৮টা থেকে রাত ৭টা খোলা থাকে।

আনন্দ সংবাদ

যাবতীয় রেডিমেড পোষাকের উপর ১৫ থেকে ৪০ শতাংশ ছাড় এবং ধুতি ও শাড়ীর উপর বিশেষ ছাড় দেওয়া হচ্ছে।

বিশাখা ষ্টোর্স

কাঁথি বাজার

মেনকা

গ্রীল গেট কোং

কাঁথির পার্শ্ববর্তী

অযোধ্যাপুর, (রসুলপুর রোড)

যাবতীয় গ্রীল গেট, রোলিং সাটার ইত্যাদি অতিকম মিস্ত্রীর দ্বারা নতুন প্রস্তুত করা হয়।

২১ বর্ষ ২৫৪ সংখ্যা ★ ১৯ পৌষ '৮৯ ● মঙ্গলবার ★ ৪ জানুয়ারী ৮৩

খেজুরী উন্নয়ণ পরিষদ

কাঁথি মহকুমার প্রধানতঃ তপশীল জাতি বসতি যুক্ত থানা। স্বাধীনতার পরের ৩৫ বছরে যতগুলি নির্বাচন হয়েছে প্রতিবারেই ঐ এলাকা তপশীল জাতি নির্বাচনী এলাকা বলে সংরক্ষিত থেকেছে। এবং প্রতিবারেই স্বাভাবিক ভাবে তপশীলজাতি যুক্ত প্রার্থী জয়ী হয়েছেন। একবার বাংলা কংগ্রেস, একবার জনতা ও একবার বামফ্রন্ট প্রার্থী ঐ নির্বাচিত হয়েছেন।

রাতের অন্ধকারে বে-আইনী ব্যাবসা

● জানুয়ারী, বড়দিনের রাতে সমুদ্রপুর থেকে একটি লরীতে বালিগড় পাচার করার সময়ে – রামচন্দ্র নগরে ব্যবসায়ী ও চালক ধরা পড়ে। কয়েক ব্যক্তিকে তিনশো সত্তর টাকা দিলে লরীটি ছাড়া পায় বলে সংবাদে প্রকাশ। পরে পিছাবনী বাস ষ্ট্যাণ্ডে আবার লরীটিকে আটক করা হয়। সেখানেও জনৈক প্রভাবশালী ব্যক্তিকে সাতশো টাকা উৎকোচ দিলে লরীটি ছাড়া পায়। স্থানীয় বাসিন্দাদের অভিযোগ সামুদ্রিক কচ্ছপ হত্যা বন্ধ হওয়া সত্ত্বেও রাতের অন্ধকারে বে আইনী ব্যবসা ফলাও ভাবে চলছে।

কিন্তু কয়েক মাইল পিচ রাস্তা হওয়া ছাড়া খেজুরীর সার্বিক উন্নয়ণ এখনও অবহেলিত খেজুরীতে প্রয়োজন অনেক কিছুই। তাই খুব শিগগীর খেজুরীর সাধারণ মানুষ আর এম-এল-এ, এম, পি-দের উপর নির্ভর না করে—নিজেদের চেষ্টায় একটি উন্নয়ণ পরিষদ গঠনের কথা ভাবছেন। এখন শুধু ভাবনার স্তরেই আছে। জনৈক মুখপাত্র (নাম প্রকাশে অনিচ্ছুক জানালেন আপাততঃ তাঁরা কেবল মাত্র দুইটি দাবী নিয়ে গণ স্বাক্ষর সংগ্রহ অভিযানে নামবেন। প্রথম দাবী

"DAINIK CHETANA" dated 4.1.1983

(Bengali Daily published from Contai)

Irregular business in the darkness of night

Dated 3rd Jan. 1983

A businessman and the driver were caught when they tried to transport turtles in the night of Christmas day. It is reported that the lorry was released on payment of Rs.370. The lorry was again stopped at Pichabani bus stand and a bribe of Rs.750 had to be given to an influential man to release the lorry. The local inhabitants complained that illegal business is flourishing well in the darkness of night although capturing of sea turtles is prohibited.

NESTING SITE AND HATCHING OF THE HAWKSBILL TURTLE ALONG TIRUNELVELI COAST OF TAMIL NADU*

In the year 1975, the Central Marine Fisheries Research Institute began regular investigations on turtles as a research project. As a part of this programme mapping of the nesting sites of turtles along south Tamil Nadu Coast including the islands of Gulf of Mannar was undertaken. In pursuance of this study, every year during the nesting season in this area, from September to early February periodically walking trips in the night hours were made along the coast, backed by the knowledge accumulated over the past by the local fishermen. Even though there are evidences of turtle nesting all along the coast of Tirunelveli and Kanyakumari Districts the core area of nesting is demarcated as the stretch between Manapad and Periathalai, villages 20 km south of Tiruchendur.

This stretch of seashore between the villages aforementioned is about 8 km long and is very much jagged with the presence of sandstone formations. The seashore either stretches flat landward to some 60 m or rises to a height of 9 m abruptly from the high tide water mark. In other locations the beach is 1 m high from the sea level without a slope. Owing to this condition there are relatively a few patches of sea shore which is gradually sloping up to allow a turtle to climb up from the sea and crawl beyond the high tide water mark.

From the night trampings carried out by the Institute staff it became known that olive ridleys usually were nesting in this belt and the season almost coincides with that of Madras Coast. From our observations it became known that olive ridleys seem to be less shy as evidenced by their selection of nesting sites right in the fish landing centre of Periathalai or Manapad which are ever pestered by stray dogs round the clock. During the period of our observation it was a matter of routine with the local fishermen to capture the egg laying turtle which unwittingly chooses the fish landing centre as their nesting site by overturning them and later butchering them. The eggs were boiled and sold for five paise each. It has been estimated that as many as 40 turtles were captured on the shore when they were laying eggs. Now owing to the intervention of Wild Life officers this method of easy capture of turtles is being phased out.

On 28th December, 1980, a nest with 103 eggs was noticed at about 0230 hrs on following the track left by a turtle. The eggs were found to be different from those of olive ridley. They were dirty white in colour as opposed to olive ridleys eggs which are bright white, 30 to 35 mm in diameter and weighing about 25 gm each. Upon seeing the difference in colour and size of the eggs, they were transported in a 50 litre plastic storage bin with sand from the seashore to Tuticorin Research Centre of CMFRI, 60 km away by jeep. Owing to the terrain of the seashore and poor condition of the road, the eggs had been subjected to heavy jolting.

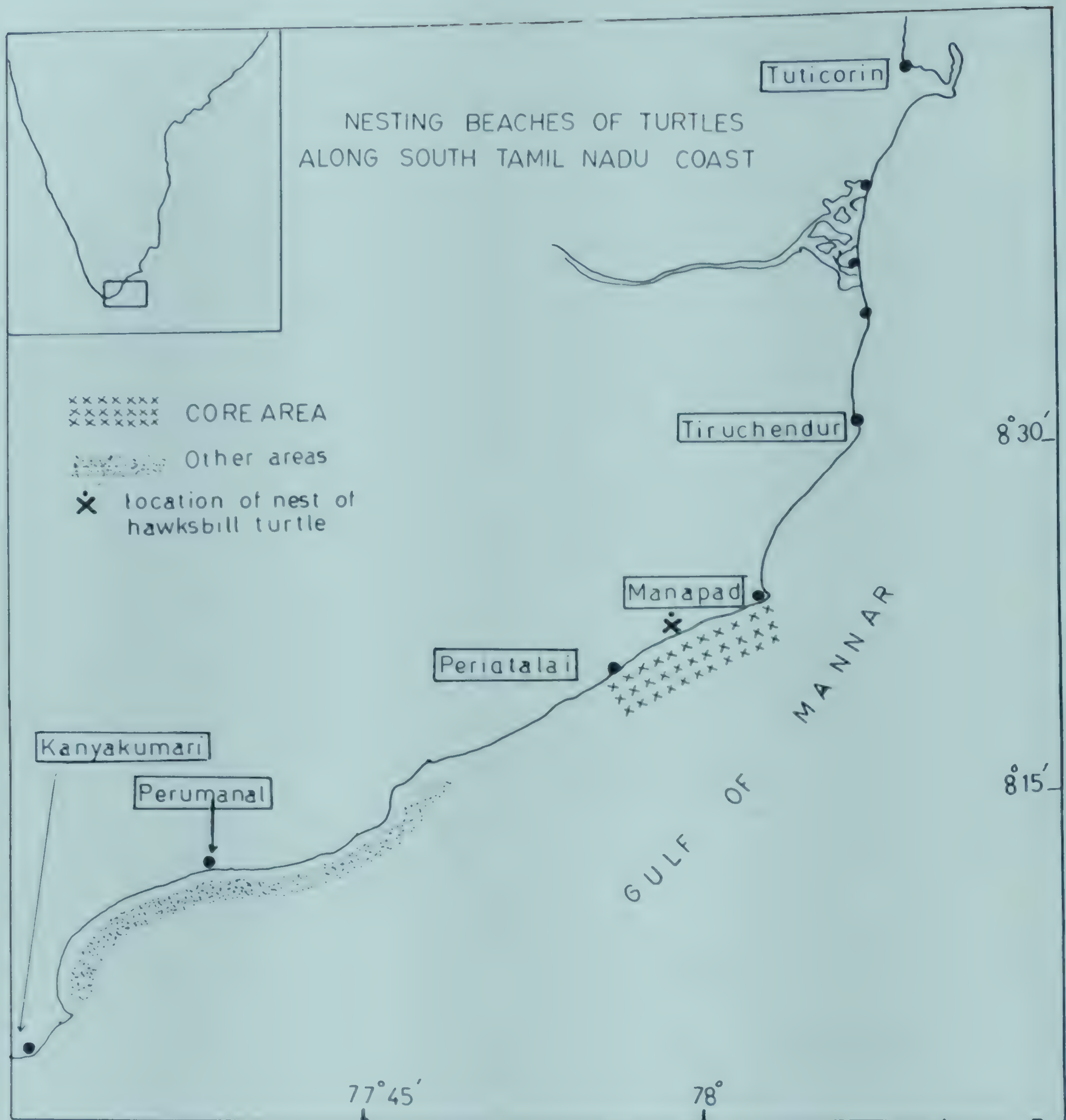
The very same day the eggs were burried near the sea in a rectangular pit with coarse sand. The eggs were evenly spread in two tiers. The pit was 50 cm deep and was just one metre away from the high tide water mark. On rainy days the pit was covered with water proof canvass as the ground was clayey without the possibility of good drainage of rain water. On hot days in February sea water was sprinkled over the pit. On 23.2.81 that is, after 57 days, the first batch of hatchlings of hawksbill turtles *Eretmochelys imbricata* emerged as indicated in the following Table. In total 63 hatchlings came out bringing the rate of hatching to about 63 per cent.

Date	No. of hatchlings Morning	Evening	Total
23-2-'81	5	4	9
24-2-'81	10	6	16
25-2-'81	9	8	17
26-2-'81	0	8	8
27-2-'81	3	2	5
28-2-'81	4	0	4
1-3-'81	2	0	2
2-3-'81	2	0	2
	35	28	63

It is believed that heavy jolting of eggs during transport, clayey soil of the pit where they were buried and sprinkling of water on eggs must have had some effect on the hatching rate of the eggs.

It was interesting to note that all the hatchlings did not come out on one day or two but through eight

*Prepared by A. Bastian Fernando.



days. Young ones emerged from the pit either in the morning or in the evening between 1600 hrs and 1800 hrs. They moved away from the pit in all directions.

The colour of the carapace of the hatchlings was chrome yellow with brown margins. The carapace margin was smooth, not serrated as seen in adults, and scutes on carapace were fused, not imbricated. The plastron was yellow. When released into plastic tubs with 10 cm column of water the hatchlings showed much agility and soon they began to float with the front flippers tucked under the plastron as if dead, probably to conserve their energy as their intake of food had not begun. Measurements were made before releasing them into the sea.

Carapace length	35 mm
Carapace width	26 mm
Weight	12 gm

A few of the hatchlings were kept in the laboratory for studies and the rest were released into the sea from the nearby island Karaichalli Tivu where coral reefs and sea weeds are available.

LEATHERBACK TURTLE *DERMOCHELYS CORIACEA* WASHED ASHORE AT KOVALAM, MADRAS*

Of the five species of sea turtles occurring in the Indian seas, the leatherback turtle *Dermochelys coriacea* (Linnaeus) popularly known as 'Eluvarai amai' or 'Dhoni amai' is rare. The egg laying habits of *D.coriacea* has been described by Deraniyagala (1939). Bhaskar (1979, 1981) reported on the nesting grounds and capture of this species in Lakshadweep and Andaman Islands. The nesting of leatherback turtle along the Kerala Coast has been reported by Cameron (1923) and Jones (1959) and along the Andhra Coast near Visakhapatnam by Dutt (1979). The washing ashore of the carcass of a female *D. coriacea*, 35 km south of Madras near Kovalam fishing village is recorded here.

Description

The body of the adult is smooth skinned, without any scutes; carapace is black with seven longitudinal ridges and plastron with five longitudinal ridges. Upper jaw with a well defined cusp on each side, giving the horny beak a W-shaped appearance when viewed from front; flippers without claws and the anterior much larger and posterior broadly connected with tail by a web. The carapace is dark brown to almost black; whitish spots on neck increasing in number on the ventral and caudal areas.

This species is said to nest three to four times in a year but the peak intensity is during May and June. The eggs vary from 50 to 55 mm in diameter and weigh from 70 to 80 gm. The period of incubation is from 50 to 70 days. The carapace length of hatchlings varies from 80 to 85 mm and weighs about 32.5 to 33.5 gm. The species is predominantly pelagic and highly migratory and found usually in the open sea.

Distribution

Western Central Atlantic, northward extending to Nova Scotia, Canada, southward to Rio de la plata, Argentina, Mediterranean, Eastern Atlantic from the British Isles to Cape of Good Hope; Pacific and Indian Oceans.

Details of specimen recorded at Kovalam

A female leatherback turtle (Plate I) was washed ashore near Kovalam, Chinglepet District, Tamil Nadu on 28th March 1982. The carcass was in an advanced state of decomposition and in almost two pieces, the anterior part of the carapace was almost disconnected from the posterior part. The seven ridges on the carapace were clear in the anterior part and the plastron was completely exposed. Head was incomplete, only the posterior portion of the head was attached to the body. The lower jaw was intact. The fore flippers were elongate while the hind flippers were damaged. In Table 1 the stranded specimen is compared with the specimens reported along the Kerala Coast.

Table 1. *Details of leatherback turtle reported along Kerala and Tamil Nadu Coasts*

	Off Quilon (after Cameron, 1923)	off Calicut (after Jones, 1959)	Off Madras (present record)
Reported in	1923	July 1956	March 1982
Carapace length (cm)	213.3	190.5	195
Carapace width (cm)	—	116.8	119
Plastron length (cm)	—	—	162 (incomplete)
Plastron width (cm)	—	—	102 (incomplete)
Head width (cm)	—	—	34
Length of anterior flipper (cm)	—	—	110
Length of posterior flipper (cm)	—	—	85
Weight (kg)	272.4	—	—
Sex	Female	Female	Female

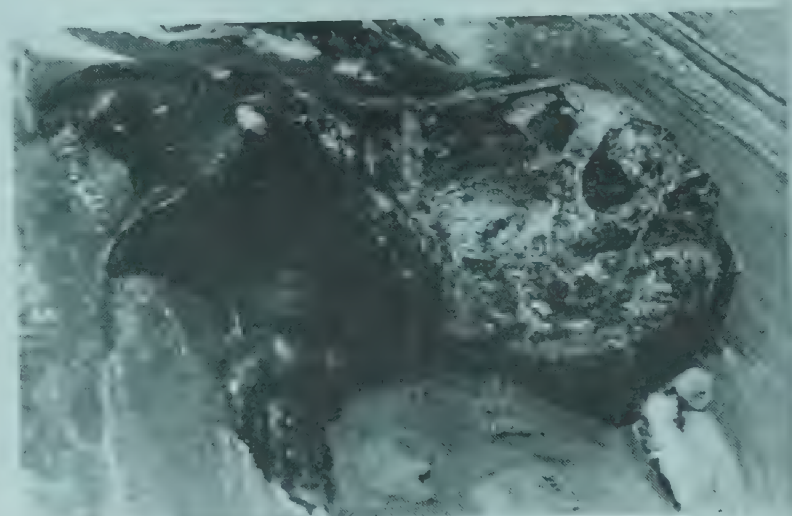
*Prepared by M. Rajagopalan.

Leatherback turtle *Dermochelys coriacea* ashore
at Kovalam, Madras

Stranded leatherback turtle, at Kovalam Beach

Dorsal view of the same

Close up view of the head



Ventral view showing the decomposed state.

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CONSERVATION OF FRESH WATER TURTLES OF INDIA*

The focus in the recent past has been on sea turtles. The hardshell and softshell freshwater turtles from Indian Coast is a very neglected group. Except for taxonomic studies and a few stray observations on their life history practically nothing is known of our freshwater turtles. In Table 1, a list of the freshwater species of turtles and tortoises occurring in India is given and of these Indian softshelled turtle *Lissemys punctata punctata*, Indian tent turtle *Kachuga tecta tecta*, Peacock marked soft-shellled turtle *Trionyx hurnum* and three Keeled turtle *Geoemyda tricarinata* find a place in Schedule I of the Wildlife (Protection) Act 1972. While the Act in Schedule I mentions, Tortoise (Testudinidae, Trionychidae) it will be desireable to

Table 1. *List of fresh water species of turtles occurring in India*

Scientific name	Common name
Family: Emydidae (Hard-shelled Freshwater turtles)	
Batagur baska	The common Batagur or Tuntong
Cuora amboinensis	Amboina or Malayan box turtle
Hardella thurji	Brahminy river turtle
Morenia petersi	
Geoclemys hamiltoni	Black pond turtle
Kachuga tecta tecta	Indian *tent turtle*
Kachuga tentoria	
Kachuga tentoria circumdata	
Kachuga smithi	
Kachuga dhongoka	
Kachuga kachuga	
Kachuga sylhetensis	
Heosemys silvatica	
Melanochelys tricarinata	Tricarinate turtle
Melanochelys trijuga trijuga	Common pond terrapin
Melanochelys t.indopenisularis	
Melanochelys t. thermalis	Common hard shelled terrapin or Ramnad pond turtle
Melanochelys t. coronata	Malabar pond terrapin
Cyclemys mouhoti	
Cyclemys dentata	
Family: Testudinidae (Tortoises)	
Geochelone elegans	Indian star tortoise
Geochelone (Manouria) emys	Burmese brown tortoise
Geochelone elongata	Red nosed tortoise
Geochelone travancorica	The Travancore tortoise
Family: Trionychidae (Soft shelled turtles)	
Lissemys punctata punctata	Indian spotted flat shelled turtle
Lissemys punctata granosa	Southern soft shell turtle
Chitra indica	Narrow headed soft shelled turtle
Trionyx gangeticus	Ganges soft-shell turtle
Trionyx leithi	Nagpur soft-shell turtle
Trionyx hurnum	Peacock soft-shell turtle

specify the species, once more information becomes available. There is an urgent need for a critical appraisal of the population structure and hibitat of the species of freshwater turtles to see whether any species needing protection have been left out. The status survey currently being conducted by Professor E.O.Moll, Vijaya and Satish Bhaskar in India should bring to light very useful information. While we eagerly look forward to their report, we take an opportunity to record some observation made in West Bengal on freshwater turtle trade. The people of West Bengal, while they shun marine fish do not mind consuming sea turtles as well as freshwater turtles. The trade in freshwater turtle in the West Bengal market is one of long standing and as late as 1983 season there was no indication of any diminution in the trade.

Observations in West Bengal

During November and December 1982, when the CMFRI team visited Calcutta and adjacent places, the sale of freshwater turtles was noticed at the Howrah whole sale fish market and Shealdah fish market. At Shealdah the freshwater turtle *Lissemys punctata punctata* was mainly sold in large numbers. They were stored alive and sold in stalls in the fish market and were also sold openly on the footpath on Mahatma Gandhi Road every afternoon. During the visit on 17th December '82 it was noticed that more than 100 turtles were kept for sale inside the market and these were sold by weight and some were slaughtered and the meat sold by weight. Outside the market the turtles were sold alive at the rate of Rs.9 per kg. About 500 turtles were kept for sale on 17th December '82 and of these about 300 turtles were in the weight range of 2 to 3 kg (plastron length 19-21 cm; plastron width 12-14 cm) about 200 turtles in the range 1 to 2 kg (plastron length 13-15 cm and plastron width 8-9.5 cm). Customers who purchased more than one kg of turtle were given a few fresh water turtle eggs free of cost. It is understood that fresh water turtle trade activity at Shealdah market happens only in the afternoon hours.

The team again visited Calcutta and Contai in February and March 1983 and gathered additional information on freshwater turtle trade. Contai fish market was visited on Sunday 20th February '83 and sale

*Prepared by M. Rajagopalan and S.S. Dan

Freshwater turtles for sale at Shealdah market, Calcutta.

A buyer of freshwater turtle at Shealdah market.

Turtle seller displaying his wares at Contai fish market

A close-up view of *L. punctata punctata*, Indian soft shell turtle.

of the fresh water turtle *L. punctata punctata* was noticed. From the enquiry it was found that the turtles were brought from Howrah whole sale fish market every Sunday and resold at Contai. The details of measurements of *L. punctata punctata* in cm taken from the specimens kept for sale are as follows:

Carapace length 18-28 (24.7)	Carapace width 15-23 (18.4)
Plastron length 13-31 (20.2)	Plastron width 12-24 (16.1)

During February and March 1983 also freshwater turtle trade was noticed at Howrah wholesale fish market and Shealdah fish market. At the Howrah market on 22nd February '83 more than 50 turtles of two species *Chitra indica* and *L. punctata punctata* were noticed. They were sold at the rate of Rs. 8 to 9 per kg. Details of measurements of turtles in cm are given below:

Chitra indica	Plastron length 41-50	Plastron width 36-49
L.punctata punctata	Carapace length 18-26	Carapace width 16-23
	Plastron length 13.5-24	Plastron width 12-20

On 22nd February '83 when the team visited Shealdah market, the sale of fresh water turtles were again in evidence and the species mainly *L. punctata punctta*. Details of measurements in cm of six specimens are as follows:

Carapace length 19-27 (23.6)	Carapce width 16-23.5 (19.9)
Plastron length 13-30 (21.2)	Plastron width 11 20 (15.5)

From the enquiry it was found out that the trade in freshwater turtles goes on throughout the year despite the protected status of the species. The freshwater turtles are collected from Naraj, Golari, Paguda and Tickkerpara in Orissa and transported to Calcutta. The important centres in Uttar Pradesh from where turtles are booked by rail to Calcutta are Sikendara Road, Izatnagar, Bednam, Bhogipura and Collegeganj. From our observations it is evident that freshwater turtles are received at Calcutta markets regularly from one source or another despite the protection afforded under the Wildlife (Protection) Act. The sign boards displayed by the West Bengal Forest Department prohibiting sale of turtles and turtle products mentions the protection of marine species only.

General remarks

The study of freshwater turtles and their life history, ecology and behaviour need to be intensified in order to understand

a. their population structure and behaviour,
b. reproductive potential,
c. habitat limitations; and
d. effect of pollutants on turtles and so on.

There is also a need for an active extension programme to make available information on turtles and tortoises to the public particularly educational organisations, if any effective management measures are to be developed.

The authors are thankful to Dr. E.G. Silas, Director of CMFRI for his constant encouragement and guidance.

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE
TURTLE HATCHERY PROGRAMME, KOVALAM, MADRAS

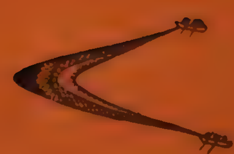
Back to sea after nesting.

Turtle hatchery at CMFRI, Kovalam.

Newly hatched olive ridley.

Release of olive ridley hatchlings.

Compiled and prepared by M.J. George, G. Subbaraju, S.K. Dharmaraja and K. Rengarajan.
Published by Dr. M.J. George, Senior Scientist on behalf of the Director, Central Marine Fisheries Research Institute, Cochin-682 018. Phototypeset and printed at PAICO, Cochin-31.



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